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The Sunning of America: Migration to the Sunbelt

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The Sunning of America: Migration to the Sunbelt

By Jeanne C. Biggar

Abstract—With birth rates down in all regions, the continuing movement to the West of migrants within the United States and the reversal of the historic outflow from the South, particularly after 1970, have been the main factors in the rapid population growth of the 15 "Sunbelt" states within those two regions from 61 million (about a third of the U.S. total population) in 1970 to 85 million (40 percent of the total) in 1977. This *Bulletin* examines the main streams these recent migrants have followed; their characteristics compared to those of the general U.S. population, people already living in the Sunbelt, and migrants to or within the Snowbelt; the factors which have attracted both industry and people to the Sunbelt; and the benefits and problems for the communities at the receiving end. Although the new influx has helped bring the South in particular more in line with the rest of the nation economically and politically, the rapid growth carries with it the threat of central city-suburban racial segregation hitherto unknown in the Sunbelt and strains on the environment, housing, transportation, schools, facilities for the aged, and other services which planners must balance successfully against new demands for lower tax burdens if the Sunbelt states are to "continue to provide the quality of living which the new migrants seek to enjoy."

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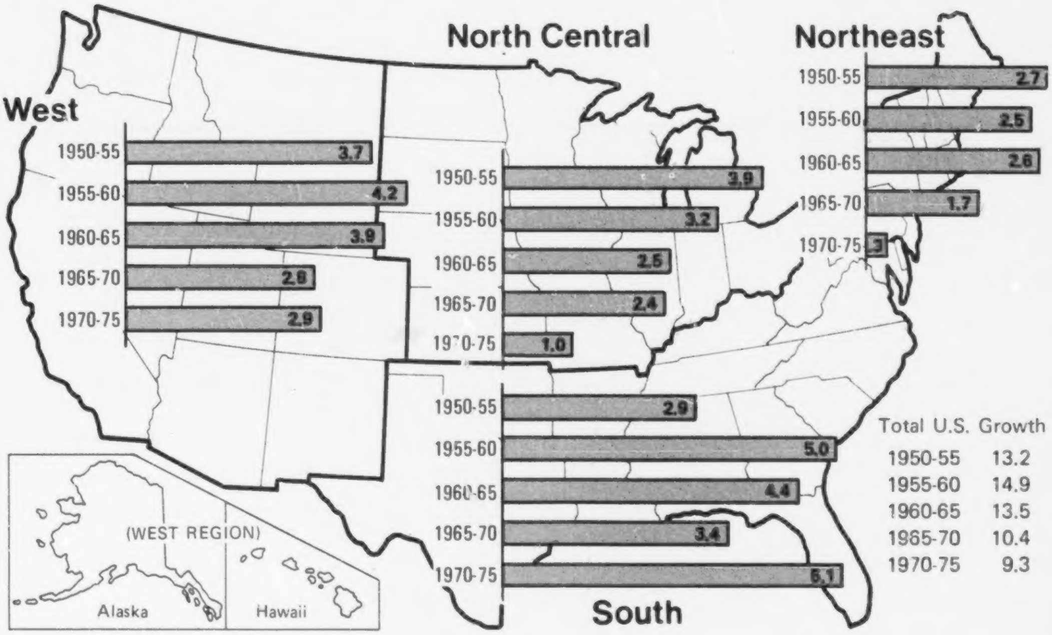
Figure 1. Population Growth in the Four U.S. Regions: 1950-1975

(Numbers in millions)


North Central
Northeast
West
1950-55
3.7
1955-60
4.2
1960-65
3.9
1965-70
2.8
1970-75
2.9
1950-55
3.9
1955-60
3.2
1960-65
2.5
1965-70
2.4
1970-75
1.0
1950-55
2.7
1955-60
2.5
1960-65
2.6
1965-70
1.7
1970-75
.3
1950-55
2.9
1955-60
5.0
1960-65
4.4
1965-70
3.4
1970-75
6.1
South
(WEST REGION)
Alaska
Hawaii
Total U.S. Growth
1950-55 13.2
1955-60 14.9
1960-65 13.5
1965-70 10.4
1970-75 9.3

Components of the Population Change

(Numbers in millions)

Period	Natural increase[a]					Net migration[b]				
	United States	Region				United States	Region			
		North-east	North Central	South	West		North-east	North Central	South	West
1950-55	12.1	2.3	3.5	4.5	1.9	1.0	0.4	0.4	-1.6	1.9
1955-60	13.2	2.6	3.9	4.7	2.2	1.7	0.0	-0.7	0.3	2.0
1960-65	12.0	2.3	3.3	4.2	2.2	1.5	0.3	-0.8	0.3	1.7
1965-70	8.7	1.6	2.3	3.0	1.7	1.7	0.1	0.1	0.4	1.1
1970-75	6.8	1.0	1.8	2.5	1.5	2.5	-0.7	-0.8	2.6	1.4

Source: U.S. Bureau of the Census, "Estimates of the Population of States with Components of Change: 1970 to 1975," *Current Population Reports*, Series P-25, No. 640, November 1976, cover chart and Table B.

[a] Births minus deaths.

[b] Balance between in-migration and out-migration.

The Sunning of America: Migration to the Sunbelt

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Dr. Biggar wishes to acknowledge the help of Cynthia Flynn, Robert Wiseman, and Charles Longino, Jr., her colleagues in a study of elderly migration in the United States, sponsored by the Institute for Social and Environmental Studies of the University of Kansas and funded by the National Institute on Aging, and the helpful comments received in the preparation of this Bulletin *from Leon F. Bouvier and Calvin L. Beale.*

> "There are men dressed in traditional wide-brimmed hats, tooled boots and other clothing detailed with a western flair. But mostly they're decked out in spiffy new leisure suits, white shoes and broad grins. Tanned entrepreneurs, quick with a hearty handshake and a slap on the back for the good buddies, a bit more formality tempered with an easygoing friendliness for the Yankees. Older men in straw Sunday hats, men who'd be more at home tall in the metal seat of a farm tractor, slouch in the wooden folding chairs which seem to have taken root in the fresh macadam and wait for the plant dedication to begin. Perspiration trickles in small rivulets down the temples of well-dressed women sporting hairdos which run the gamut from haute coiffure to Loretta Lynn. They watch the speakers file onto the platform: the chatter—a polyglot of mostly Southern drawl spiked with Middle Atlantic nasal twang and a few genuinely foreign accents—trails off. . . . This is the Sunbelt. A good 20 years behind the sophisticated, industrialized North—and hopefully at least that far behind the North's festering sore of crime and corruption. The Sunbelt is joining the mainstream of the industrial U.S. and the mood is festive."—Ira Black, "Sunbelt: Myth or Mecca?", *Iron Age*, March 7, 1977, p. 39.

The Sunbelt—the U.S. frontier of the 1970s—is now the most rapidly growing segment of this nation. The emerging mix of people from the North and East—some of whom are returning South—with those already in the South and West reflects a radical change in historical regional distribution patterns of the U.S. population. Pivotal to the change is the South. With both the highest birth rates and highest out-migration rates of any region, the South became known as America's breeding-ground in the century following the Civil War. By 1970, however, even with declines in both white and black fertility, but with the tide of out-migration reversed, the South joined the West as a rapidly growing region. Within these two regions, as we shall see, most newcomers have moved into the states which make up the Sunbelt, as defined below and depicted in the maps on pages 18, 20, and 22.

New regional growth patterns

Figure 1 (page 2) illustrates the remarkable shifts in population growth patterns that have occurred among the four U.S. regions since 1950. Numbers added to the Northeast and North Central regions have fallen steadily. The West, however, has grown consistently by some 2.8 to 4 million people during each five-year period, while the South has fluctuated between additions of 3 to 5 million. After a drop to 3.4 million in the second half of the 1960s, the South then registered a larger increase than the three other regions combined in the first half of the 1970s—5.1 versus 4.2 million.

Besides these distinct changes in patterns of population growth, there has also been an important shift in the two components that make up that growth—natural increase and net migration--as seen in the table at the bottom of Figure 1. With birth rates down everywhere, natural increase (births minus deaths) has fallen in all four regions but particularly in the South. Meanwhile net migration has continued to be important in the growth of the West, and the South has shifted from being on balance an exporter of people to an importer, most dramatically from 1970 to 1975 when net migration added six times more to the South's population than it had in the previous five years—2.6 million versus 400,000. As a result, natural increase and net migration have contributed about equally to population growth in the South and West since 1970.

It is this larger population growth of the South and the West and the increased importance of net migration in that growth that underlie the new regional population distribution pattern. This pattern in turn is the major factor in the growth of the Sunbelt.

Sunbelt versus Snowbelt

There is no one accepted listing of which states make up the Sunbelt and, contrariwise, the Snowbelt. Neither area is recognized by the U.S. Bureau of the Census. States which fall within the four official Census Bureau regions—Northeast, North Central, South, and West—and divisions within those regions are listed in the box on the opposite page. Because timely data on migration are often available only for the four regions, demographic analysis has tended to combine the West and the South to indicate the Sunbelt even though the climate of many Western states does not fit that image—Montana, Wyoming and Colorado, for instance. In this *Bulletin*, we do look at regional migration, comparing the West and the South with the Northeast and North Central regions. But for our Sunbelt story, the lines are drawn more realistically

A common definition of the Sunbelt popular with the media takes in all states of the "Confederate South" (see box), plus Oklahoma, New Mexico, Arizona, and California. This comes closer to the climatic concept of the Sunbelt and covers most states which have experienced heavy in-migration since 1970. One recent writer drew the line along the 37th parallel, thus excluding Virginia from the above Sunbelt grouping, cutting off California north of San Francisco, and adding in the southern tip of Nevada.[1] Climatically this makes sense but the definition rules out the use of Census Bureau migration data which are presented on the basis of traditionally defined political units. Another Sunbelt analysis by several distinguished economists and political scientists gave no definition at all![2]

For this *Bulletin*, the Sunbelt is drawn to include those Southern and Western

States Included in Varying Definitions of U.S. Regions

Confederate South

Virginia, North Carolina, Tennessee, South Carolina, Georgia, Florida, Alabama, Missisippi, Arkansas, Louisiana, Texas

Sunbelt as defined in this Bulletin[a]

Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Texas, Oklahoma, Missouri, New Mexico, Arizona, California

Regions and Divisions as defined by U.S. Bureau of the Census

Region	Division	States
Northeast	New England	Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut
	Middle Atlantic	New York, New Jersey, Pennsylvania
North Central	East North Central	Ohio, Indiana, Illinois, Michigan, Wisconsin
	West North Central	Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
South	South Atlantic	Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida
	East South Central	Kentucky, Tennessee, Alabama, Mississippi
	West South Central	Arkansas, Louisiana, Oklahoma, Texas
West	Mountain	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada
	Pacific	Washington, Oregon, California, Alaska, Hawaii

[a] Snowbelt: All states not in Sunbelt.

states with a mild climate, recreational facilities, and expanding job opportunities in industry and services which combine to make them attractive destinations for migrants. These are the states along the nation's southeastern and southern rim, plus Oklahoma, Arkansas, and Missouri. (See box, and maps on pages 18, 20, 22.) Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas are in the Census South. New Mexico, Arizona, and California are in the Census West. Missouri—included because the Ozarks in the south of the state are a primary destination for elderly migrants—is in the southern tip of the North Central region.

All other states are consigned to the "Snowbelt." In many instances, this is a misnomer. Certainly snow is rare in Nevada and along the coastal plain of Oregon and the state of Washington. However, the division does sort out those states now experiencing the Sunbelt in-migration phenomenon so that we can distinguish that movement from the more general westward flow and inter-divisional population exchanges to the north of the Sunbelt.

In 1970, the 15 states which make up our Sunbelt contained almost one-third (61,344,702) of the U.S. population. Since then, they have absorbed almost two-thirds of the nation's growth. Together, Florida, Texas, and California have registered more than half of the Sunbelt's population increase. Florida alone has added more people than the Northeast and North Central regions combined.[3] By 1977, some 85 million people—close to 40 percent of the total U.S. population—lived in these 15 Sunbelt states.

New issues

Major shifts in population distribution such as have been witnessed in the Snowbelt-to-Sunbelt migration generate social changes in the areas losing population as well as those gaining new residents. Concern in the North and East over the decline of industrial prowess and the exodus of residents is summed up in the recent slogan, "The North Will Rise Again!" Calvin Beale aptly describes the Northern position:

> "The North, which served as an employment haven for many Southerners in earlier years, finds itself faced with a much older industrial fabric, a concentration of people in very large metropolitan areas during a period of sentiment for smaller communities, a deteriorated rail system, well advertised urban fiscal troubles, winter weather problems, and a more rigid, higher cost labor system. In such a context, it not only fails to attract as many people as it used to, but also finds itself losing more of its own population to other regions."[4]

The North, then, looks to a period of slow or no growth. But this in itself is not so troubling as the nature of the population dynamic which underlies the slow growth—out-migration. Because migrants on the whole tend to be the younger, more qualified workers, the North is losing the able youth who might be most likely to provide the creative ideas and enthusiastic leadership needed to tackle the problems associated with declining metropolitan areas.

The Sunbelt, on the other hand, must devise ways to provide education, housing, and other services for its flood of new residents while still maintaining reasonable levels of social services for current residents. Consider the 40 percent population increase in Arizona between 1970 and 1976, for example: for every five persons demanding services in 1970, there are at least seven today. Unfortunately this increasing pressure on local and state agencies in the Sunbelt is taking place just as citizens' rights groups are stirring up support for "Proposition 13" fiscal accountability.

The "Sunning of America" challenges public planners at all levels of government. In the North, where the loss of industry means a shrinking tax base at the same time that those left behind must work out solutions to rising unemployment, traffic congestion, crime, and air and water pollution, priorities must be reordered if unreduced public budgets for social and economic services are to be justified. In the Sunbelt the dilemma for planners is how to increase services while reducing tax expenditures.

The mass media has bombarded the general public with gross statistics on the numbers of people who have changed residence in the Sunbelt migration. However, public officials require more specific information about these population shifts in order to carry out rational short- and long-range planning. While it is interesting to know that the new migration to the South carries Northerners as well as returning Southern-born whites and blacks, planners need to know where they are coming from and where they are going. Migration follows well channelized streams, and planners must identify the location and direction of these streams and the proportion of migrants who are using them. To estimate what types of services will be most needed, they should also be aware of the characteristics of the migrants who are moving into specific areas. At the national level, for example, only 5 percent or so of migrants are age 65 and older. However, in Florida, approximately 20 percent of all migrants since 1970 have been retirees. Thus, for planners in Florida, the implication of migrant flows into the state is quite different from what it is in states where newcomers are much more likely to be younger people seeking jobs.

These, then, are the questions addressed in this *Bulletin*. What are the major streams which have carried migrants from one part of this country to another? Where are the emerging Sunbelt streams in the new movement to the South and continuing trek to the West? How do streams of elderly migrants compare to those for the overall population? What are the characteristics of the migrants to the Sunbelt and how do they compare with those of resident populations? Why is the Sunbelt more attractive, and why is the North and East less attractive to interstate migrants? What impact do the new migrants have on Sunbelt communities? What are the prospects for continuing migration to this emerging Sunbelt frontier?

First we take a look at what we mean by "migration."

Migration Definitions

This *Bulletin* focuses on internal migration within the U.S. and not international migration from out of the country. Thus, we omit a migration stream which is currently making its impact felt across the U.S. South and Southwest from the affluent suburbs of Dade County, Florida, to the crowded barrios of East Los Angeles—the largely illegal flow of "Hispanic" migrants now entering the U.S. at a rate estimated at more than a million a year.[5]

The U.S. Bureau of the Census—our major source of migration data—defines migration as a change of residence across a county boundary. Changes within a county are called local moves. In-migration refers to moves into a county, state, or region; out-migration to moves away from that geographical unit. Net migration is the result of the in- and out-migrations from the unit under consideration. If an area has more in-migrants than out-migrants over a particular time period, that area has experienced net in-migration.

While important in evaluating population growth and decline, net migration estimates provide little insight into the overall numbers of people moving into and out of a particular place. As Rand Corporation analyst Peter Morrison points out: "Net migratory gains or losses are only the surface ripples of powerful crosscurrents of movement, and the one-way drift of net migration is no measure of the many migratory moves that people undertake."[6] Between March 1975 and March 1978, for example, the South gained approximately 1,010,000 people through net migration. However, that was the net result of the moves of more than 4,700,000 persons in these three years—2,881,000 people moved into the South and 1,871,000 moved out.[7] Besides net migration estimates, this *Bulletin* uses gross in-migration estimates to provide a clearer image of the numbers and characteristics of the migrants who are descending upon Sunbelt communities.

Young migrants versus the elderly

Americans are highly mobile. In the 1950s and 1960s approximately one in five U.S. households changed residence every year. That rate has slowed in the 1970s to about one in six.[8] Most movers are not migrants, however, that is, persons who move across a county line. Of the some 70 million persons aged

3 and over who changed addresses within the U.S. between March 1975 and March 1978, just over 28 million, or 40 percent, moved across at least a county line and can thus be considered migrants.[9]

Migration rates vary significantly by age and, because migration tends to be linked to job changes for career mobility and changes in life cycles, young adults are more highly represented among migrants than older adults. Younger migrants tend to move to areas with better economic and housing opportunities. The post-World War II industrialization of the South has improved both economic and housing opportunities in that region. Therefore, it is not surprising that the tide of general migration has swung southward.

Although older people are popularly viewed as stable and resistant to change, migration (that is, moving to at least another county) has been increasing among the U.S. elderly population in recent decades. Between 1935 and 1940, approximately 7 percent of Americans aged 65 and older changed their county of residence. Between 1965 and 1970, almost 9 percent did so. However, the migration rate for the general population increased considerably more over the same period—from 12 to 20 percent.[10]

Among the elderly, migration tends to be linked with such critical life events as retirement, loss of a spouse, or a health problem which disrupt former social relationships. Thus, elderly migrants often seek destinations which offer milder climates, well-developed services for the aged, and opportunities for leisure-time activities where they may establish new social networks.[11] Climate-wise the Sunbelt appeals to the elderly more than much of the Snowbelt. In addition, several Sunbelt states—California, Florida, Arizona, and Texas—have promoted commercialized recreational and health service centers for the aged to national renown. With the availability of Medicare and larger shares of American workers now covered by Old Age Survivors Insurance (Social Security) and other pension plans, more and more of the elderly now feel financially secure enough to seek out these advantages.

The different reasons which prompt young people and the elderly to migrate would lead us to expect differences between the Sunbelt migration patterns of the general population and those of the elderly. Hence, this distinction is made wherever possible in this *Bulletin*.

Internal Migration in U.S. History

With national birth rates at a record low level, the movement of people in and out now figures more importantly than ever in determining whether different areas of the U.S. grow or decline. But internal migration has always been a dynamic force in U.S. history.

The settlement of the Western frontier was accomplished by the movement of second and third generation colonists, augmented by immigrant streams from western and northern Europe. This 19th century migration stream has continued to be significantly large throughout most of the 20th century. Until well after World War II, the westward movement of America was accompanied by two other major streams. One was rural-to-urban migration. Each decade since the turn of the 20th century has found larger shares of America's population living in urban areas. The large flow of migrants from the South to the Northeast and North Central regions beginning in the late 19th century, particularly of black people after World War I, comprises the third major movement.

Westward trek continues

By 1970, only the first of these three historic streams of internal migrants remained what it was in former decades.

Photo: American Association of Retired Persons

Sailors head for home at a lavish retirement community in Florida. Net in-migration added 1.5 million to Florida's population between 1970 and 1977 and some 20 percent of the migrants have been retirees.

California, still the primary destination of Western migration, has had a major role in the growth of the West. "From the Gold Rush in 1849 to the great exodus from the Dust Bowl in the 1930's to a huge migration of people seeking aerospace jobs and bungalows in the San Fernando Valley during and after World War II, in-migration has been as characteristic of California as its benign sun, scalloped coastline and pragmatic styles of living."[12]

During the 1950s and 1960s California welcomed an average 1,000 migrants a day. In the 1960s, net in-migration added 2.1 million to California's population compared to just 800,000 in that of the twelve other Western states (including Alaska and Hawaii).[13] Aircraft factory shutdowns, student rebellion, and the San Fernando Valley earthquake slowed the intake during the early 1970s. Although in-migration picked up again by 1975, California's gain through net migration amounted to just about 800,000 people in the first seven years of the 1970s. Meanwhile the gain for the balance of Western states rose to about one and a third million.[14] Among these are Arizona, which has grown particularly rapidly since 1970, and New Mexico. Together with California these make up the three Western states included in our definition of the Sunbelt and thus the continuing westward migration is a significant factor in the growth of the Sunbelt.

Rural-urban turnaround

The 19th and 20th century movement to the West was accompanied by the movement of people from rural to urban areas. Internal migration expert Calvin Beale describes the history of this national stream:

"The United States was so overwhelmingly rural in its early years that it took 100 years of subsequent faster growth of towns and cities from 1820 to 1920 to reach the point where urban people first outnumbered rural people. The political shock from the rural-to-urban movements of the World War I period was so great that Congress could not agree on an apportionment formula for the House of Representatives following the 1920 Census."[15]

After World War I when the tractor and other gasoline-powered machinery replaced men and draft animals, the flight from the farm accelerated. World War II further uprooted the rural worker so that over the 30 years before 1970 millions moved to the city, leaving behind hundreds of depopulated rural counties.

By 1970 the rural-to-urban stream had become negligible, partly because of the small numbers of people still residing in rural areas. But because this stream had been such an integral part of our history, demographers were skeptical when Beale first pointed to its reversal.[16] From 1970 to 1977, for the first time since the turn of the century, overall population growth was higher in nonmetropolitan areas (10.7 percent) than in metropolitan areas (4.4 percent. Termed Standard Metropolitan Statistical Areas [SMSAs] by the federal government, metropolitan areas are those which contain a county with a city [sometimes two] of at least 50,000 inhabitants, plus surrounding counties which are primarily dependent upon the central city for jobs and services.) Some 2.3 million more people moved into nonmetropolitan counties than moved out of them between 1970 and 1975. These same counties had lost about 3 million people by net out-migration during the 1960s.[17]

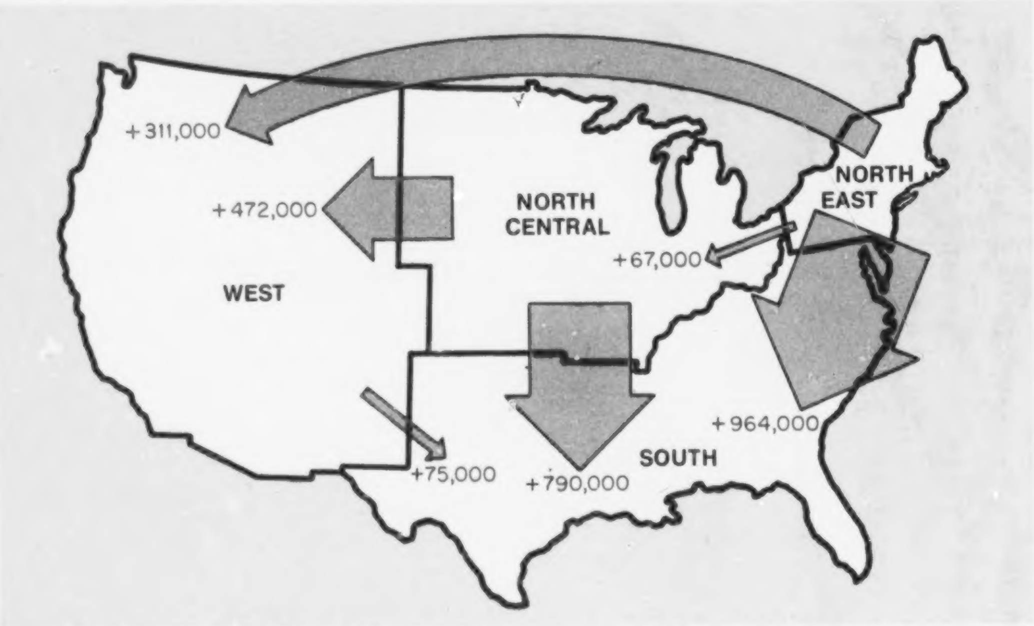
The slowdown in metropolitan growth has been concentrated in the largest metropolitan areas—those with two million or more people. In contrast to net in-migration of 1.8 million in the 1960s, these largest metropolitan centers lost 2.2 million persons through net out-migration from 1970 to 1976—almost identical to the in-migration gain of the rural areas and small towns which make up nonmetropolitan areas. Small and medium-sized metropolitan areas with less than 750,000 people are continuing to attract migrants at higher rates than during the 1960s.[18]

These trends are most evident in the South in particular and in the West and, indeed, go far toward explaining the recent surge in Snowbelt-to-Sunbelt migration.

Northerners now spurning the nation's largest and oldest cities for the more relaxed if less lucrative life of the open countryside or small towns might well turn to the South. With over a third of its population still living in nonmetropolitan counties, compared to one-seventh in the Northeast, for example, the South remains the most rural region of the nation.[19] Further, the South and the Sunbelt states of the Western region contain more than their share of retirement centers located well away from bustling cities. Beale has found that, outside of growth in nonmetropolitan counties next to metropolitan areas, which can be considered urban spillover, the "rural renaissance" which began developing during the 1960s was most closely associated with retirement communities—defined as counties with a high in-migration of persons aged 60 years and over. The 360 such fast-growing counties which he identified in 1970 doubled their growth rates in the next five years and, to judge from 1975 county data on persons aged 65 and over, have now been joined by many more specialized retirement communities. Beale's associate researcher at the U.S. Department of Agriculture, Vera Banks, points out that, in addition to traditional retirement centers in Florida and Southwestern states, many of the new areas attracting elderly persons are located in the Sunbelt as defined by this *Bulletin:* for example, the Ozarks (straddling Arkansas and Missouri); the hill country of central Texas; the Sierra Nevada foothills in California; and the east Texas coastal plain.[20]

Banks also points out that metropolitan living is on a smaller scale in the

Figure 2. Directions of Interregional Net Migration Flows: U.S., 1970-1975



Source: Adapted from Brian J. L. Berry and Donald C. Dahmann, *Population Redistribution in the United States in the 1970s* (Washington, D.C.: National Research Council, National Academy of Sciences, 1977) Figure 4.

South than elsewhere. Only a fifth of the South's metropolitan population lived in large metropolitan areas in 1974 compared to three-fifths in the two Northern regions and the West. Thus, the South has been less affected by the slowdown in large-city growth while its relatively more numerous small and medium-sized cities have continued to grow, as have those of the West. In fact, the South was the only region where population growth in metropolitan counties as a whole from 1970 to 1975 was higher than for the nonmetropolitan sector—9.3 versus 6.9 percent. In sum, as Banks observes, "The South [has been] a benefactor of the general shift of population growth down the residential scale, whether it be into the smaller SMSA's or into rural areas and small towns."[21]

This shift has fed into the reversal of the third major U.S. internal migration stream—the historical movement of both whites and blacks from the South to the North (and the West to some extent.)

South-North migration reversal

"Seedbed of the nation," the South was a primary exporter of people through World War II.[22] Long the most underdeveloped and rural area of the U.S., the South lagged behind as technological change and industrialization surged in the Northeast and later in the West. Thus, poor whites and blacks had little choice but to trek north or west in search of jobs as the Depression struck hard in the South's farmlands and later when King Cotton was mechanized, sharecropping abandoned, and Southern cotton lost markets to other fibers and regions.[23] Even after World War II, most

Southern states exported more people than they received.

Florida has consistently gained population by net in-migration since the mid-1950s—some 1.3 million between 1960 and 1970, for example, which increased the state's population by almost one-fourth over the total of 1960. Until 1970, the continuing though diminishing losses of most other Southern states partly negated Florida's gains. However, by 1977, all states in the South could boast of net population gains through migration.[24] Indeed, in the first seven years of this decade, the other 15 Southern states registered even more net in-migration (2 million) than Florida (1.5 million), adding up to a total increase of 5.5 percent over the region's 1970 population.

In absolute numbers, the South's migration reversal has been accounted for primarily by whites. Blacks continued to register net out-migration from the South during the 1960s as they had since the Civil War. But the picture began to change for blacks also during the early 1970s. By 1975-78, Census Bureau surveys showed that the flows of blacks in and out of the South were at least in balance and may actually have tipped to net migration into the South.[25]

Although newspapers and magazines have given wide coverage to stories of "Southerners going home," return migration was not the most important factor in the early years of the South-to-North migration reversal. Using "state-of-birth" data from the 1960 and 1970 censuses, Census Bureau demographers Larry Long and Kristin Hansen have found that, although the return of Southern-born migrants to the South stepped up during the 1960s, the two most important factors in the shift to net in-migration during that decade were a decrease in the rate at which native Southerners left the South and increased migration of non-Southerners into the South.[26] Even among return migrants there is some doubt as to how many were really "going home." More than two-fifths (43 percent) of white migrants and a third (34 percent) of blacks did *not* return to their state of birth. Whether or not return migration became more important after 1970 when the North-to-South tide accelerated will not be known until detailed data are available from the 1980 census.

To sum up, of the three major migration streams which have traditionally redistributed the U.S. population, only one, the movement West, continues in full force today. The earlier rural-to-urban tide has ebbed and has now been overtaken by a sizeable movement from metropolitan to nonmetropolitan areas, and the earlier outflow from the South has also reversed direction. We now take a closer look at the interregional migration patterns which have contributed to the nation's population shifts.

Recent Interregional Migration Patterns

In an analysis of 1970-75 data for the National Academy of Sciences, Brian Berry and Donald Dahmann confirmed that migrants to the South in the first half of the 1970s came overwhelmingly from the North, as illustrated in Figure 2 (page 11). The net balance of migrants moving between regions shows the South far out in front with a gain of 1.8 million and the West in second place with 783,000. All but a fraction of the South's gain was at the expense of the North Central and Northeast regions and it is clear that the pre-1950 South-to-North tide has indeed reversed in full force. Further, the former South-to-West movement has also reversed; the net movement between these regions, even though small, is southward rather than westward. It is also clear that the movement to the West from the North and East continues. Data from the Census Bureau's monthly Current Population Survey on moves between March

Table 1. Where Migrants Within the U.S. Went Between 1975 and 1978, by Region: Total, Elderly, White, and Black

Region of origin	Total number of migrants[a] (000's)	Percent who stayed in region	Destination of those who left their region (percent)			
			Northeast	North Central	South	West
Total migrants						
Northeast	5,134	69.3	—	17.7	57.3	25.0
North Central	7,593	71.4	11.4	—	52.3	36.3
South	9,282	79.9	23.8	37.8	—	38.4
West	6,125	75.1	12.0	32.7	55.3	—
U.S. total	28,134	74.6	12.3	20.8	40.3	26.6
Elderly migrants[b]						
Northeast	295	61.7	—	7.1	77.0	15.9
North Central	309	71.5	6.8	—	46.6	46.6
South	317	83.3	32.1	43.4	—	24.5
West	255	81.2	12.5	35.4	52.1	—
U.S. total	1,176	74.3	9.6	15.9	50.7	23.8
White migrants						
Northeast	4,578	70.3	—	17.3	56.1	26.7
North Central	7,082	78.3	11.0	—	53.1	35.8
South	8,221	80.4	25.2	37.2	—	37.6
West	5,613	74.8	12.1	33.6	54.3	—
U.S. total	25,494	75.1	12.5	20.6	40.6	26.3
Black migrants						
Northeast	467	62.0	—	15.8	67.8	15.8
North Central	411	60.8	8.1	—	56.5	35.4
South	985	75.2	16.0	44.7	—	39.3
West	261	67.4	10.6	20.0	69.4	—
U.S. total	2,124	68.6	9.2	23.1	40.5	27.2

Source: U.S. Bureau of the Census, "Geographical Mobility: March 1975 to March 1978," *Current Population Reports*, Series P-20, No. 331, November 1978, Table 7.

[a] All persons aged 3 or more who moved across at least a county line.

[b] Migrants aged 65 years or more.

1975 and March 1978 indicate that this 1970-75 pattern of interregional migration persists to the present day.

To achieve population growth when natural increase is low, a region must retain its own residents at the same time that it attracts new residents from other areas; that is, out-migration rates must be low and in-migration rates high. Table 1 illustrates that this was indeed true of the South and West in the most recent period for which data are available: March 1975 to March 1978. Among all migrants—persons who moved across at least a county line—the percent in the South and the West who chose to stay in their own region was higher (79.9 and 75.1 respectively) than the national average (74.6 percent), and their regional out-migration rates thus lower than those of the Northeast and North Central regions.

In addition to their higher "migrant retention rates," the South and the West also attracted the largest shares of migrants who crossed regional boundaries (columns 3 through 6 in Table 1). Of all the nation's interregional migrants, two in five (40.3 percent) chose Southern destinations, and the South drew more than half of all people who left the other three regions. The West was second in each case.

The South also clearly dominated the destination choices of the elderly and both white and black migrants, attracting more than half (50.7 percent) of all the elderly and about 40 percent of all the white and black migrants who moved across regional boundaries. The South appears to be a particularly strong favorite for interregional migrants among these three subgroups in the Northeast where more than three-fourths of the elderly (77.0 percent), two-thirds of blacks (67.8 percent), and more than half (56.1 percent) of whites chose a Southern state.

All in all interregional migration patterns since 1970 verify that the westward movement continues, that the pre-1950 exodus from the South has reversed, and the South is now the primary destination for migrants within the United States. However, this still leaves the questions of whether recent migrants to the South and the West are choosing the Sunbelt states within those two regions and which routes they are most likely to follow. To answer these, we must turn to state-to-state migration data because our classification of Sunbelt and Snowbelt states cuts across regional groupings. With such data, we can look at the overall flow from Snowbelt to Sunbelt and pinpoint the origin and destination of flows into each of the Sunbelt states.

Snowbelt-to-Sunbelt Migration Established, 1965 to 1970

The most recent state-to-state migration data available come from the 1970 census. With the stepped-up pace of migration into the Sunbelt since 1970, these data undoubtedly underestimate the numbers of migrants now involved in specific interstate streams. However, they do shed useful light on the *patterns* of Snowbelt-to-Sunbelt migration. While newer streams have no doubt emerged since 1970, the established streams which will continue to carry the majority of migrants are revealed in a study based on data for the 1965 to 1970 period which were drawn from the one-in-one-hundred "public use" sample tape of the 1970 census, using the records of all interstate migrants in the sample and a subset of persons aged 60 or more.[27] (The age cutoff for

Table 2. Where Sunbelt and Snowbelt Interstate Migrants Moved Between 1965 and 1970

	General migration to/within			Elderly migration[a] to/within		
	Sunbelt	Snowbelt	Total	Sunbelt	Snowbelt	Total
	Percent		Number (000's)	Percent		Number (000's)
Sunbelt	51.2	48.8	6,485	56.4	43.6	338
Snowbelt	41.0	59.0	10,505	59.0	41.0	775
Total	44.9	55.1	16,991	58.2	41.8	1,123

Source: All interstate migrants on Public Use One-in-One-Hundred Sample Tape of 1970 U.S. census.

[a] Interstate migrants aged 60 or more.

Note: For states included in the Sunbelt and the Snowbelt, see box, page 5.

"elderly" migrants was set at 60 rather than 65 in order to cover the increasing number of persons who retire early.)

What proportion of migrants choose the Sunbelt?

As noted earlier, the 15 Sunbelt states as defined in this *Bulletin* contained about one-third of the U.S. population in 1970. Therefore, if migrants distributed themselves in proportion to population numbers, we might expect the Sunbelt to have attracted a similar proportion of all migrants who moved from state to state between 1965 and 1970. In fact, however, as seen in Table 2, almost half (44.9 percent) of all interstate migrants chose to move to or remain in the Sunbelt. Among interstate migrants originating in the Sunbelt, more than half (51.2 percent) moved to other Sunbelt states, and Sunbelt destinations were the choice for 41.0 percent of all interstate migrants originating in the Snowbelt.

Using the same proportionality principle, it appears that the Sunbelt had an even stronger attraction for elderly interstate migrants in this period. In 1970, 35.4 percent of the U.S. population aged 60 or more lived in the 15 Sunbelt states. However, as also seen in Table 2, 58.2 percent of all interstate migrants of this age chose Sunbelt states between 1965 and 1970. Among elderly interstate migrants in the Snowbelt, the proportion moving to the Sunbelt was 59.0 percent.

Favorite Sunbelt states

The continuing migration to the West and emerging migration to the South between 1965 and 1970 clearly centered on the Sunbelt states within those regions. However, the influx was not shared equally among the 15 Sunbelt states. Three Sunbelt states—California, Florida, and Texas—ranked highest in numbers gained among all the nation's interstate migrants during this period, as seen in Table 3 on the next page. California attracted the largest proportion of any state (10.5 percent) and together with Florida, Texas, and Virginia, accounted for more than a quarter (26.6 percent) of total interstate migration during this five-year period. Migrants entering these four Sunbelt states came to about the same number as those entering the other six among the ten top receiving states which were all highly industrialized Snowbelt states.

As might be expected, the Sunbelt also held the three top positions among receiving states for elderly interstate migrants. Florida alone attracted almost a quarter (23.5 percent) of all the nation's elderly interstate migrants and together with California (in second place) Arizona (third) and Texas (sixth) accounted for more than two in every five (40.9 percent) of all interstate migrants aged 60 or more. Although the six other top-ranking states of destination for elderly migrants were in the Snowbelt, two of these—Washington and Oregon—have relatively mild climates, particularly along their shared Pacific coastline. Both appear to be emerging retirement centers.

The impact of general in-migration was greatest in Florida where more than one-sixth (17.9 percent) of the 1970 population had moved into the state over the preceding five years. In Virginia, one of every eight residents in 1970 (12.8 percent) had moved into the state over that period. This probably reflected continuing expansion of the federal government which drew people to locate in the Virginia suburbs to the south of Washington, D.C., and Vietnam War activities which brought armed forces migrants to Virginia's several military bases.

Even more impressive is the implication of migration of the elderly for Florida and Arizona where some 20 percent of the 1970 population aged 60 or more had arrived during the preceding five years. In these two states, for every five elderly persons to be housed and

Table 3. Top Ten Receiving States in General and Elderly Interstate Migration: U.S., 1965-1970

Destination state	General migration				Elderly migration[a]			
	Rank	Number of in-migrants (000's)	Percent of nation's inter-state migrants	Percent of state's 1970 population	Rank	Number of in-migrants (000's)	Percent of nation's inter-state migrants aged 60 or more	Percent of state's 1970 population aged 60 or more
California	1	1,784	10.5	8.9	2	107	9.5	4.3
Florida	2	1,215	7.2	17.9	1	263	23.5	20.0
Texas	3	915	5.4	8.2	6	40	3.6	2.7
Illinois	4	700	4.1	6.3	10	23	2.6	1.9
New York	5	672	4.0	3.7	8	33	2.9	1.1
Ohio	6	648	3.8	6.1	9	32	2.9	2.1
New Jersey	7	605	3.6	8.4	4	46	4.1	4.3
Virginia	8	596	3.5	12.8				
Pennsylvania	9	538	3.2	4.6				
Michigan	10	520	3.1	5.9				
Arizona					3	48	4.3	19.9
Washington					5	41	3.7	4.5
Oregon					7	34	3.0	6.3
Total			48.4				60.1	

Source: See Table 2.

[a] Interstate migrants aged 60 or more.

served in 1965, there were six in 1970.

If the rising tide of Sunbelt migration during the latter half of the 1960s was largely directed into a few specific Sunbelt states, was it also identifiable in terms of origin? From which states in the Snowbelt and Sunbelt were these migrants mostly coming? Here, again, we turn to a proportionality principle to single out what are known as "salient" migrant streams.[28] If, for example, the migration stream from New York to Florida is larger than would be expected in terms of all the nation's interstate migrants who originate from New York and the percent of all migrants received by Florida, that stream exceeds Florida's proportionate share of migrants leaving New York. It is such salient state-to-state streams which define the major migrant flows into and within the Sunbelt and which can help planners in understanding the nature of the new residents who will be seeking jobs and services.

Based again on the state-to-state migration data for 1965-70 available from the 1970 census, the maps in Figures 3 and 4 display the salient streams from the Snowbelt to the Sunbelt and those within the Sunbelt for interstate migrants in general and for the elderly. Figure 5 combines this information to reveal the Sunbelt states which led in attracting migrants from long distances between 1965 and 1970 and those which pulled extra large numbers of migrants from states closer at hand.

Salient general migration streams

The pattern of salient streams from Snowbelt to Sunbelt states for overall migration pinpoints those Sunbelt states which depend to a greater extent on northern migrants (top panel, Figure 3, next page). Florida, California, Missouri, Virginia, and Arizona all had at least four salient streams of migrants of all ages from the Snowbelt. As we have seen, Florida, California, and Virginia were also among the top ten destination states for all interstate migration between 1965 and 1970 (Table 3).

All four of Florida's salient streams originated long distances to the north in New York, New Jersey, Michigan, and Ohio. Arizona also had several long-distance streams reaching from Michigan and Illinois in the eastern part of the North Central region across three central states—Iowa, Minnesota and Nebraska—to Montana, Washington, Oregon, and Nevada in the Western region. Arizona, with ten, had the largest number of salient streams from the Snowbelt and appeared to be emerging as a primary destination for migrants in the western two-thirds of the country.

Snowbelt migrants to California, the leading destination for all 1965-70 interstate migration, tended to come from nearby states. Except for those from Hawaii and Alaska, all California's streams were from adjacent states or states next to those.

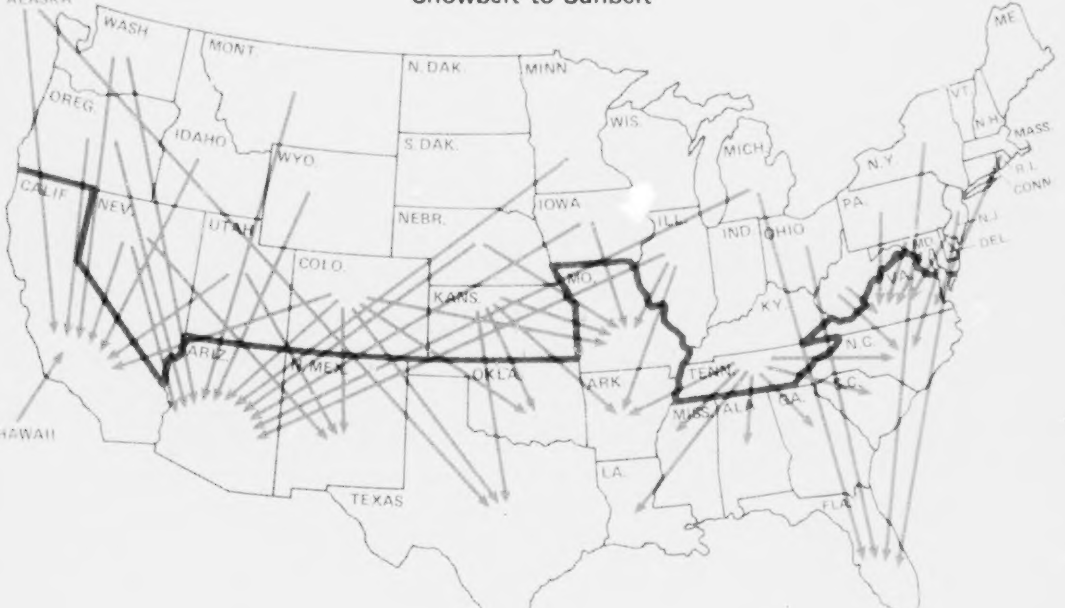
The salient migration streams into Missouri and Virginia were even more localized. Missouri had a stream from Colorado, but the others were from adjacent states. Five of Virginia's streams came from nearby states. The sixth was from Rhode Island, probably composed mainly of military families who joined one of Virginia's east coast naval bases.

Each of the other ten Sunbelt states had at least one salient migration stream from the Snowbelt. Texas, New Mexico, Arkansas, and North Carolina had three apiece, mostly from adjacent states or within their own Census division, although Texas had a long-distance stream from Alaska which could well have been made up of oil workers returning from work on the Alaskan pipeline.

Only at a very general level does the Snowbelt-to-Sunbelt migration appear to be focused at the point of origin. The states which sent migrants to the Sunbelt span the country. At the same

Figure 3. Salient Streams of General Interstate Sunbelt Migration: U.S., 1965-1970

Snowbelt to Sunbelt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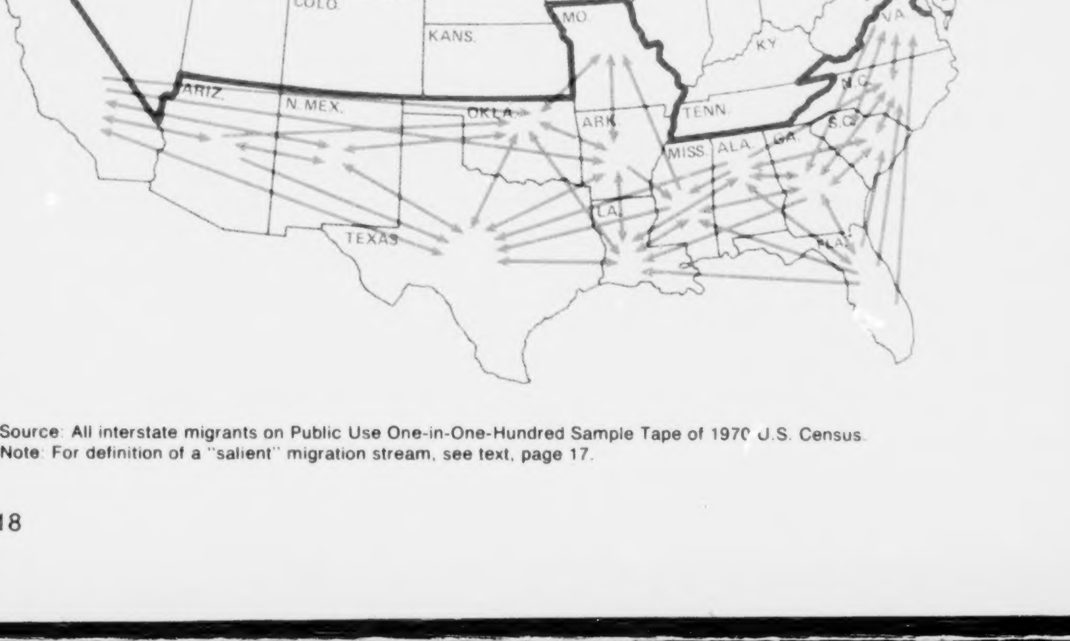
Sunbelt to Sunbelt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Source: All interstate migrants on Public Use One-in-One-Hundred Sample Tape of 1970 U.S. Census.
Note: For definition of a "salient" migration stream, see text, page 17.

time there appears to be a dividing line in terms of whether Snowbelt migrants go east or west. Except for streams from Michigan to Arizona and from Tennessee to Louisiana and Arkansas, an imaginary line from the lower tip of Lake Michigan, south along the Mississippi River, divides the flows. However, within these two areas, the Snowbelt origins are generally scattered. An exception in the east is Tennessee which was the origin for streams to each adjacent Sunbelt state in an arc from North Carolina west through Arkansas and also sent a significant number of migrants to Louisiana. To the west, Colorado was a primary Snowbelt origin state with salient streams to Missouri, Oklahoma, Texas, New Mexico, Arizona, and California. Both Tennessee and Colorado had large in- and out-migration flows between 1965 and 1970. It seems likely that many migrants leaving those states chose Sunbelt destinations.

Two types of Sunbelt migration destination emerge from this picture. One tends to pull its migrants over long distances from origins spread across the nation. Florida and Arizona are examples. A second type draws its migrants from states which are adjacent to the Sunbelt destination or at least within the same Census region. California, Virginia, and Missouri fit this regional model.

These two types of destination also appear in the pattern of salient streams between states within the Sunbelt (bottom panel, Figure 3). Here, the two centers of national migration—Florida and Arizona—had the fewest (two) salient streams, while each of the three regional migration centers—California, Virginia, and Missouri—had at least three salient streams from other Sunbelt states.

The two leading within-Sunbelt migration centers were Texas and Oklahoma. Texas not only attracted a significant number of migrants from states adjacent to its boundaries, but from California, Arizona, Alabama, and Mississippi as well. Similarly, Oklahoma had significant streams from four adjacent states and also from California and Louisiana. Migration into Oklahoma became important only about 1970 and has picked up momentum since then.

Salient elderly migration streams

Because persons aged 60 or more accounted for only some 6 percent of total interstate migration between 1965 and 1970, their movements cannot be inferred from patterns of general migration. But these are important to identify since the impact of elderly in-migration on destination communities is so different.

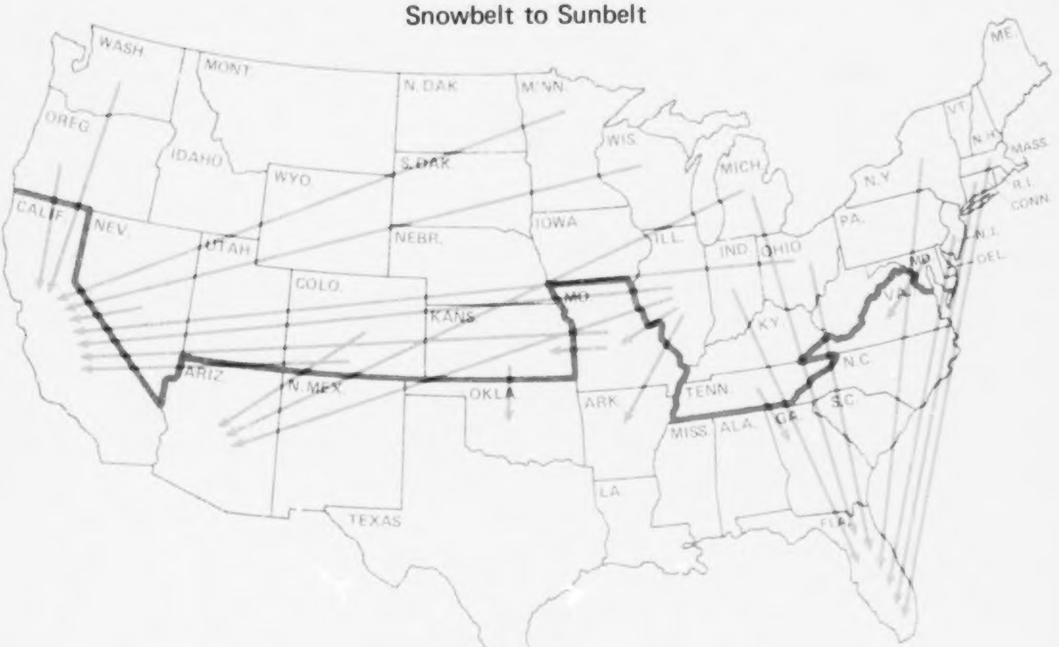
The Snowbelt-to-Sunbelt pattern for the elderly is less complex than that of general migration (top panel, Figure 4). Elderly migrants were highly directed toward three states—Florida, California and Arizona—which together received over three-quarters of all these salient streams. These states appear to be national centers for elderly migration for each attracts migrants from long distances.

Four of California's eight salient streams came from its own Western region, but the other four reached well into the midwest—Minnesota, Wisconsin, Ohio, and Illinois. All seven of Florida's streams originated far to the north. Two of Arizona's streams were also from the midwest—Michigan and Illinois—while the third came from nearby Colorado. Other significant Sunbelt destinations received only one or two streams. Missouri and Arkansas probably make up a single elderly destination centered on the Ozarks, an emerging retirement area, which overlaps these two states.[29]

Similar to the pattern for general migration, an imaginary line running south from Lake Michigan along the Mississippi River divides the elderly migration streams to Florida in the east from the streams to California and

Figure 4. Salient Streams of Sunbelt Interstate Migration of the Elderly[a]: U.S., 1965-1970

Snowbelt to Sunbelt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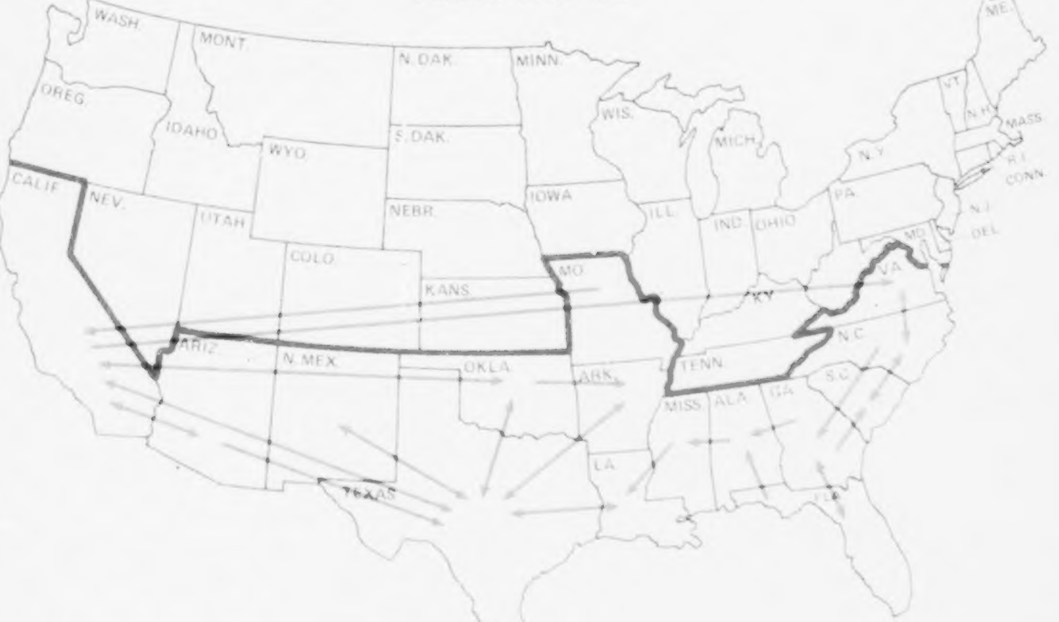
Sunbelt to Sunbelt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Source: See Figure 3

[a] Migrants aged 60 or more.

Arizona in the west, with the one exception of a stream from Michigan to Arizona.

The pattern of Sunbelt-to-Sunbelt elderly migration is diffuse (bottom panel, Figure 4). Only one destination state stands out. Texas had salient streams from all states adjacent to it, plus long-distance streams from California and Arizona. An interesting feature here is that Texas not only received substantial influx from six states, but also lost people in return to all of them except Arizona.

The remainder of significant elderly flows were mostly between adjacent states and many were also reciprocal (indicated on the maps by double-headed arrows). Those which were not two-way moved from the eastern part of the Sunbelt south and west toward Texas and those in the western part of the Sunbelt also terminated in the central area around Texas, Oklahoma, and Arkansas.

Elderly migration patterns point to the same two types of Sunbelt destination centers as found in general migration. California, Florida, and Arizona are national centers pulling elderly migrants from far-distant Snowbelt origins. Texas and, perhaps, Missouri-Arkansas appear to be regional centers with elderly migrants coming primarily from adjacent states.

National and regional Sunbelt migration centers

Distance plays an important role in migration. Migrants who move over long distances tend to be fewer in number but of higher status, however measured, than those who settle closer to home. Thus, the distinction between national and regional migration destination centers is important in terms of both the size of the migrant stream and the kinds of migrants found in each stream. Figure 5 combines the pattern of salient streams of general migration and of the elderly for the three major national Sunbelt centers (top panel) and for the five major regional Sunbelt centers (bottom panel).

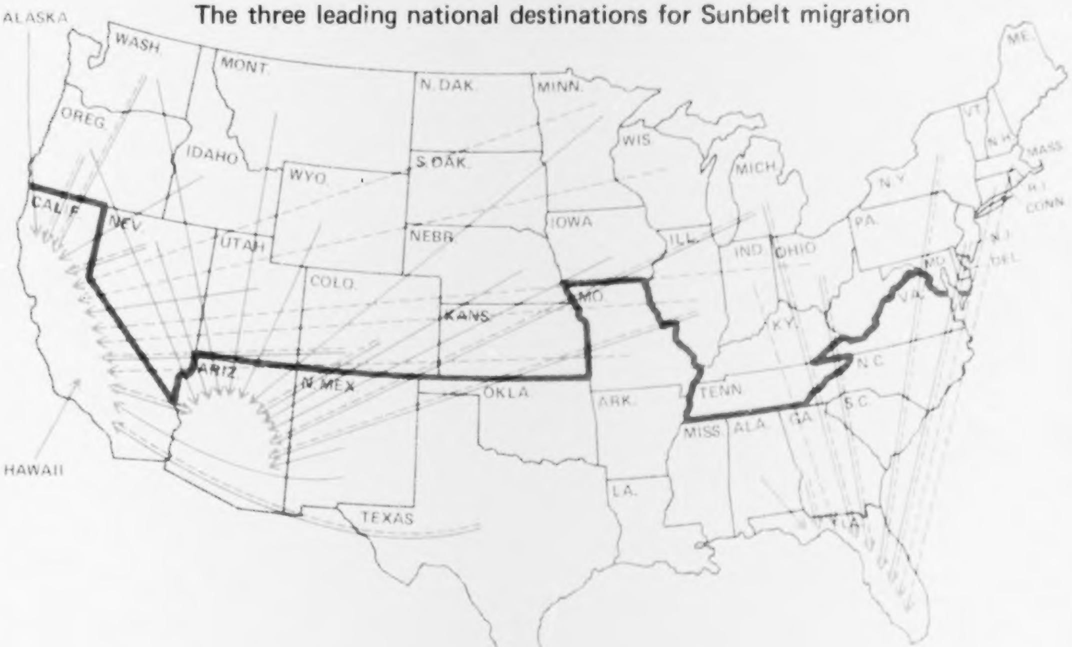
The national character of migration into California, Arizona, and Florida is striking. California's general migration flows were fairly localized but, when combined with the elderly flows, its salient streams fan out across the western two-thirds of the nation. In Arizona it was the general migration streams which originated from all over the west but, when elderly streams are added in, it is clear why Arizona is now one of the country's most rapidly growing states. California and Arizona together attracted most of the migrants headed toward the southwest. For the eastern third of the country, Florida was the national migration focus of both general and elderly interstate migrants. Apart from the two local flows from Georgia and Alabama, both general and elderly migrants traveled long distances from the Northeast and the eastern North Central region to enjoy the Florida sunshine.

Movement into the five main regional centers also varied geographically. Virginia was the main regional center in the east, attracting general migrants from adjacent states as well as Florida and Rhode Island although only two significant local flows of the elderly. Those migrants in the western two-thirds of the nation who did not go into one of the western national centers tended to concentrate in Missouri and Arkansas (the Ozarks area), Oklahoma, or Texas. Texas, which pulled from all its adjacent states in addition to California, Arizona, Colorado, Mississippi, and Alabama, was the leading regional Sunbelt destination.

In sum, state-to-state migration data indicate that, even before 1970, the Sunbelt states attracted nearly half of the nation's interstate migrants and over half of elderly migrants. Further, with just one-third of the U.S. population in 1970, these 15 Sunbelt states draw

Figure 5. National and Regional Migration Destinations: U.S., 1965-1970

The three leading national destinations for Sunbelt migration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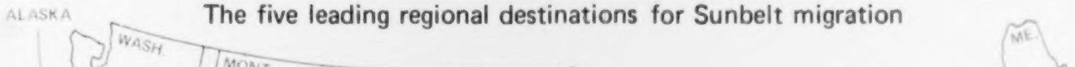
The five leading regional destinations for Sunbelt migration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——— Salient general migration streams

- - - - Salient elderly migration streams (migrants aged 60 or more)

Source: See Figure 3

approximately three-fourths of migrants entering the South and West Census regions. The Sunbelt migration is due primarily to moves from the Snowbelt rather than moves within the Sunbelt itself and is focused on a few specific Sunbelt states. California and Arizona in the west and Florida in the east attract disproportionate numbers of Snowbelt migrants from long distances—the kind likely to be of higher status and thus presumably better able to support themselves in their new communities of residence. Texas appears to be the leading destination for migrants moving shorter distances within the Sunbelt itself. Migrants from the Snowbelt to the Sunbelt apparently still feel that "East is East and West is West" for, at least between 1965 and 1970, Snowbelt-to-Sunbelt migration streams were generally divided east and west by the Mississippi River.

All in all, it is obvious that the Sunbelt migration is more than a myth conceived and perpetuated by the media.

Attractions of the Sunbelt

What attracts Americans to the Sunbelt? There are many answers, but more than anything the rise of the Sunbelt is evidence of changes in the U.S. economic structure and in the lifestyles of its people that are as much qualitative as geographical.

Today, U.S. economic initiative and wealth are becoming fairly evenly distributed throughout the country. But, from the Civil War to the years preceding World War II, the Northeast dominated the South and the West. Northern harbors, inland waterways connected by man-made canals, and railways monopolized economic exchanges between the agricultural heartlands and the great cities of the east. By the mid-19th century, New Orleans, for example, once the major port for trade with continents to the east and south, was restricted to the transport of Southern agricultural crops up the Mississippi and out its tributaries. Southern reliance on a one-crop economy and Northern financial control of Southern industry fed into the South's dependent colonial ties with the Northeast. The dominance of King Cotton meant that the South was dependent on the North for other agricultural and industrial products. Absentee Northern owners provided the capital for the cotton plantations as well as for banks and the few manufacturing plants which developed during that period.

By 1950 the North had entered the post-industrial age, while the South stood at the threshold of economic development. In the cities of the North, both industry and people were moving away from the higher taxes and congestion of the central city to the suburbs and exurbs which offered the benefits of rural and small-town living. Some of that industry went South. First came labor-intensive, low-wage industry such as textiles and apparel, or industries oriented to natural resources such as oil and natural gas, chemicals, lumber, and paper. But later the capital-intensive industries—insurance, banking, and brokerage firms—moved South to support the emerging industrial development. More importantly, the South attracted new "leading-edge" industries, for example, small-parts electronics, and service industries such as real estate, tourism, and recreation. Ralph R. Widner of the Academy for Contemporary Problems describes it this way:

> "What is happening is that you have new plants, new expansions and new firms at a one-third higher rate in the South. The death rate [of businesses] is the same [as in the North]. But the birth rate is greater in the South."[30]

Industrial development in the South, along with stabilization (or, in some instances, decline) of industry in the

North, has closed the gap between the South and other regions. By the mid-1970s, economist William Serow declared:

> "Although some elements of southern tradition undoubtedly remain, the South in terms of economic variables such as income and industrial composition of the labor force is now, in essence, no different from the remainder of the nation."[31]

In the West, development was well under way even before World War II. Agriculture expanded by sophisticated irrigation technology, the emerging aircraft industry, and the exploitation of oil fields readily absorbed the westward migrants uprooted by the Great Depression of the 1930s.

The author Kirkpatrick Sale sums up the industrial shifts since World War II which have fostered the Sunbelt's rise:

> "In broad terms there has been a shift from the traditional heavy manufacturing long associated with the industrial belt of the Northeast to the new technological industries that have grown up in the Southern Rim—aerospace, defense, electronics—and from the dependency upon railroad transportation to the growth of air and highway transportation, both relatively more important in the Southern Rim. There has also been a development away from coal and heavy metals such as iron and steel, the resources of the Northeast, toward oil and natural gas and the light metals such as aluminum and titanium, the products of the Southern Rim. And in agriculture, new technologies have favored large-scale and often corporate farming, advantageous particularly where space is plentiful, growing seasons are long, and the crops are suitable [as in] the Southern Rim."[32]

Why industry favors the Sunbelt

What accounts for the development of industry in the Sunbelt? Industry replies, "A better climate for business!" A 1975 ranking of the 48 contiguous U.S. states on 31 criteria of business climate listed eight Sunbelt states in the top ten and none in the bottom ten ranks.[33] The major factors in business climate are the availability of energy, water, transportation, and qualified workers. The Sunbelt has always had the first two, and in the past two decades has developed the last two.

Energy is less costly in the Sunbelt for two reasons. First, the major sources for coal and gas are there or nearby and prices paid for energy thus lower than in the North. Second, the mild Sunbelt climate requires less energy for heat maintenance (even if more for air conditioning). Industry thus uses less energy and pays less for what it does use.

In terms of water, the Sunbelt as a whole is fortunate. Although the three western Sunbelt states are arid, the largest underground water supply in the world lies between eastern Texas and the Atlantic sea coast.[34] And the Sunbelt's extensive highway and water transport systems, major air terminals, and inexpensive utilities all foster an efficient transportation and communication network between industrial settings.

Several factors play into the increased availability of qualified labor in the Sunbelt. Upgrading of higher educational programs and the development of community colleges have made the traditional college education as well as general adult education accessible to most Sunbelt residents. State-sponsored recruitment and training programs for skilled and semi-skilled labor have also given Sunbelt states an edge on providing a qualified labor pool. Alabama, for example, has fully equipped mobile units for machine-shop, screw-machine, and tool-and-die training which move about the state to train and retrain workers to meet specific industrial demands. South Carolina offers free technical training to prospective workers in communities where industry locates. Over the last 15 years, 58,000 people—about a sixth of the manufacturing labor force in that state—have been trained and made available for almost 500 companies.[35]

Another factor in the availability of labor for industry is a rate of unionization about half that of the nation, thanks largely to "right-to-work" laws in all Sunbelt states except California, New Mexico, and Oklahoma. Business sees this as fostering more favorable labor attitudes and an absence of the strong adversary relationship which characterizes labor-management ties in the North. "A sentiment frequently voiced by southern plant managers: The workers at our plant seem genuinely glad to have a job."[36]

In the absence of union pressure, wages are lower than in other parts of the nation. Further, the lower levels of living to which the recent rural and small-town migrants among the Southern workforce are accustomed puts fewer demands on the wage structure. Economist Lew Mandell summarizes it this way: "All other things being equal, you get people to work [in the Sunbelt] for less money, or for the same amount of money you can get better qualified employees, particularly in the managerial area."[37]

Other factors play into the favorable business climate of the Sunbelt. There are the general benefits of milder climate. Costly slowdowns due to snow and ice are fewer and construction costs are lower because the expense of insulation is less. Cheaper and more accessible land is another plus for the Sunbelt. In the North, land prices have skyrocketed and acquisition of industrial sites is impeded by a morass of bureaucratic zoning strictures. In the Sunbelt, not only is land cheaper, but public and local officials seem generally less suspicious of industrial development than their Northern counterparts.

Along with providing a more favorable business climate, the Sunbelt—like Avis—"tried harder" to attract industry. "The hallmark of media content has been peerless boosterism: congratulate growth rather than calculate its consequences; compliment development rather than criticize its import."[38] The Horace Greeley "Go West, young man, go West" was translated into the Sunbelt "Come South, y'all, come South" by the cheerleaders of the Southern presses. Older images of abject poverty, racism, redneck dominance, and Bible Belt conservatism have been replaced by promises of "sun" and "fun.'

By 1976 even the Northern press emphasized the advantages of the Sunbelt lifestyle: the comfort of environments still relatively free of urban blight; the benefits of lower taxes and lower energy costs. *Time* magazine—once labeled a primary South-baiter—defined the South as the new center of opportunity in its September 27, 1976, issue. Using 70 journalists, "the issue was a chamber of commerce dream: overwhelmingly positive, upbeat, lavish in booster praise, while any negative aspects were sparse, buried, appended, or carefully qualified with an apologetic, euphemistic tone."[39]

In South Carolina, a recent candidate for Secretary of State, James Clyburn, claimed, "We are all working to try to create 80,000 jobs a year and keep this state economically healthy." A reporter described this effort:

> "The state that ignited the Civil War has reversed the field, rushing to embrace not only Yankees, who have been streaming in with cash, jobs and factories for 20 years, but also the Germans, the French, the Kuwaits and other foreigners who have in recent years pumped the nation's highest level of foreign investment, per capita, into this development-hungry state . . . The international selling of South Carolina, which has brought in more than 70 foreign firms and $3 billion in new investment in this decade, can be seen along the inland foothills of the Great Smoky Mountains and the sandy plains of the coast."[40]

In Georgia, every year for the last 15 years, the state Chamber of Commerce has invited 30 to 40 chief executives from the North for a four- to five-day "red-carpet tour" of what that state has to offer firms whose rising taxload makes the costs of operation prohibitive. They feel their annual $75,000 investment has paid off well in terms of industries attracted to Georgia.

Why people move to the Sunbelt

And why do people move to the Sunbelt? Partly because industry has already come and has generated new jobs for newcomers and longtime residents alike. Manufacturing jobs grew particularly rapidly in the Sunbelt during the 1960s. Despite the general U.S. recession, such jobs still rose by 432,000 (7.5 percent) in the Sunbelt in the first six years of the 1970s while declining by nearly 400,000 in the U.S. as a whole and by 769,000 in the Northeast and 185,000 in the North Central states.

Indeed, the Sunbelt states did very well in overall employment in the first six years of this decade. All except Georgia and North Carolina showed nonfarm job increases higher than the national average (14.3 percent). "In some [Sunbelt states] the increase was spectacular—40 percent in Arizona, 34 percent in New Mexico, 29 percent in Florida, and 23 percent in South Carolina. Texas, with the largest numerical gain, added 966,000 nonfarm jobs—a larger increase than that in Michigan, Ohio, and Massachusetts combined."[41] In 1977 alone, California's economy produced 700,000 new jobs for a rate of increase 30 percent higher than that of the nation as a whole.

But it is not just jobs but also the general climate, the cost of living, and the lifestyle which have brought people to the Sunbelt. Climate takes on increasing importance as people have more time and money to enjoy leisure activities. The Sunbelt offers both more "sun" and more "fun." Outdoor living, informal entertaining, and golf the year-round—all afford the new lifestyles which Americans have adopted.

The mild climate also lowers living costs. One observer, Peter Dickinson, recently found that two- and three-bedroom houses in the Sunbelt were 29 to 50 percent cheaper than in the North and East. He estimates that an intermediate standard of living in a nonmetropolitan area of the Sunbelt costs 18 percent less than in metropolitan areas across the U.S. as a whole. State and local taxes are also lower in the Sunbelt, as Dickinson points out. When he ranked states according to annual taxes paid per capita (excluding federal taxes), Florida, Louisiana, Mississippi, and Texas were among the lowest fifth. Alabama, Arizona, Arkansas, Georgia, and New Mexico were all below the national average as well.[42]

Americans continue to seek the qualities of living once associated with the suburb—the quiet life, the clean environment in which to live and bring up children. Now, however, they seem more willing to give up the advantages associated with the large metropolitan center. Higher crime rates, traffic congestion and the hassle of commuting, and "the day-to-day aggravation of having to deal with surly waitresses and cabbies, and the suffocating crush of unsmiling humanity" have discounted to some degree the opportunities for upward social mobility and cultural advantages of the great Northern metropolitan centers.[43] Calvin Beale summarizes this trend:

> "Increasingly people seem to be motivated to locate on the basis of positive opinions about the values of rural and small-town life and a more negative image about the merits of the large metropolitan area. They all need an income, but many appear willing to accept the somewhat lower incomes that accompany nonmetropolitan jobs in return for other benefits they seek."[44]

The Sunbelt provides that rural, small-town atmosphere. Even the largest cities have a rural "hospitality" about them.

Finally, the racial climate of the Sun-

Photo: American Association of Retired Persons

The Sunbelt offers plenty of scope for the outdoor activities which are part of the new lifestyles that Americans have adopted.

belt has changed. Blacks have joined the mainstream of Southern living. More and more are holding upper-level professional and managerial jobs. The South's several black mayors are evidence of not only the racial character of the central cities but also the more tolerant attitudes of the Southern-born as well as the Northern migrants. In the spring of 1978, for example, it was Republican bankers who raised funds to support the campaign of James Clyburn, a black Democrat candidate for Secretary of State in South Carolina! A black farmer revealed to a Detroit news writer why, for the first time since the Civil War, the South may soon have net in-migration of blacks. He had returned to Montgomery, Alabama, after three years in Chicago, leaving behind a good job—"but also the perils of the big city—'to live out in the more peaceful country.' He says the southern racial situation which drove many blacks North has improved greatly."[45]

The Sunbelt is part of the New South and the West which offer a wide range of alternative lifestyles. A woman from Birmingham, Alabama, speaks of the advantages she sees in "skiing in the Smokies, swimming in the Gulf, and dining in Atlanta—all just a few hours away by car." She also finds "low-cost living, affordable housing, available jobs, a strong educational system, good health care, safety, friendly people, racial harmony, environmental concern, competent local government, and a slower pace of life." For her those factors take precedence over the disco scene and earning a great deal of money.[46]

The Sunbelt migration, then, is part of a larger radical change in the South and the West. It is closely related to the industrial development which typifies most states in the "Southern Rim." It is a reflection of changing American lifestyles. It is part of the equalization of U.S. regions which has brought the South more in line with the rest of the nation.

What impact have the migrants had on the Sunbelt? To judge that, we must look at the distinctive characteristics which the new residents have brought with them.

Who Moves and Why?

Demographer Donald Bogue has summarized the abundant literature on migration "selectivity":

> "Young migrants are selected primarily along the lines of long-run basic differences and imbalances in the social and economic organization, whereas adults are selected, in addition to and to a greater extent with respect to, current personal and social problems and current social changes."[47]

Youth predominates in migration steams because as they are finishing school and exploring career possibilities young people are willing to move to "new frontiers" in order to maximize the chances for good jobs. Characteristically, they dominate migration toward areas with developing economies. It was the young who led the great migrations from northern and western Europe and later from southern and eastern Europe to man the U.S. industrial expansion of the 19th century. Similarly, the young rural resident led the rural-urban migration of the 20th century when mechanization reduced the number of workers needed in agriculture.

In this post-industrial period, migration streams continue to show disproportionate numbers of youth. In the U.S. between 1975 and 1978, for instance, migration rates were highest for young people aged 20 to 30 and then dropped to a plateau for persons aged from the mid-fifties to late-sixties before a final tapering off after age 70.[48]

Bogue's observation that older adults tend to migrate to resolve personal and social problems is supported by studies which have found that migration of the elderly stems from retirement, dissolution of a household at the death of a spouse, or a move into an institution.[49]

Sex and race also make a difference in who migrates and how far. Until the post-industrial era and the entry of large numbers of women into the labor force, migration streams contained more men than women, particularly those over long distances. These days women tend to migrate as readily and as far as men do.[50] Within the United States, whites have been more mobile than blacks and Spanish Americans. However, when they *do* move, blacks have been more likely than whites to migrate to more distant areas,[51] as in the great movement of blacks out of the South into the cities of the North and Midwest, particularly after World War I and World War II.

Migrants also tend to come from the upper socioeconomic ranks. Here, education consistently makes the difference. This is probably because the higher his educational attainment, the more likely it is an individual will know about career opportunities and the quality of living in other places. Also the better educated are more likely to be professionals or managers, occupations that usually have national, less localized markets than those open to skilled and semi-skilled workers. Indeed, career mobility for professionals and managers often dictates a long-distance move. However, migrants are relatively less numerous among client-centered professions such as law, dentistry, or medicine where the cost of migration is often too high in terms of replacing an existing panel of clients or patients. Hamilton's classic study of Southern migration using 1960 census data reveals this education selectivity most clearly.[52] Migrants both from and into the South tended to be better educated than nonmigrants regardless of age, sex, or race, and the degree of that selectivity increased with the distance traveled.

To these findings on migration selectivity, Everett Lee has added the influence of the context of migration. He argues that areas which offer favorable opportunities—those which are advancing industrially—attract migrants who are "positively" selected.[53] By this he means the more privileged migrants, whether measured by education, occupation, or income.

With its expanding industrialization, the Sunbelt offers the nation's workers a wide range of opportunities. If those who respond conform to past experience, we would expect migrants into the Sunbelt to be younger than nonmigrants on average, relatively more often white than black, and better off, better educated, and more likely to be employed in professional and managerial occupations than the general population.

Characteristics of Sunbelt Migrants

Recent data on the characteristics of migrants into the Sunbelt per se will not be available until the 1980 census. The smallest units for which there are suitable interim data from the Census Bureau's Current Population Survey are the four official regions. However, knowing that recent migration to the South and West is channeled into the Sunbelt states, we may logically conclude that migrants into these two regions are very much like those into the Sunbelt states.

A look at the characteristics of persons who migrated into the South and West between March 1975 and March 1978 compared with those of the total U.S. population reveals several of the expected differences and some unexpected (Table 4, next page).

Migrants to the South and West were younger than would be expected from the total population. The proportion of youth aged 15 to 24 who went West was more than half again as large (28.1 percent) as the proportion in the total population (19.6 percent) and the youth segment moving into the South was almost a fourth larger (22.6 percent). Young adults aged 25 to 34 were also overrepresented in the Southern migrant stream (24.0 percent as compared to 15.1 percent in the total population) and in the Western stream (27.0 percent). This youthfulness was reflected in the median age of migrants to both the South (24.5 years) and the West (25.8 years). Both were more than five years below the median for the total population (31.0 years).

There was little evidence of sex selectivity. The proportion of males in the two migrant streams was only slightly higher than that of the total population (just over 50 percent compared to 48.3 percent). This means, of course, that women are nearly as well represented as men in the South and West migration, as might be expected from recent experience.

Almost no racial selectivity was apparent in either the Southern or Western streams. Each Current Population Sample Survey since 1973 has shown more blacks moving into than out of the South. The increasing size of the black stream into the South since 1970 is, no doubt, reflected in the similarity between the racial composition of the Southern stream and that of the total population in 1978 (89.3 and 86.8 percent white, respectively). The lack of racial selectivity in the Western stream is more difficult to explain. This could indicate an emerging stream of blacks into the Western region.

As expected, migrants were considerably better educated than the general U.S. population. The proportion with upper education in the Southern stream was more than a third greater (45.4 percent) and in the Western stream more than two-thirds greater (52.4 percent) than that of the total population (30.1 percent). They were also more likely to be employed in the more prestigious professional and technical, and managerial and administrative, occupations. However, the differences here were not so great as in education.

The measure of relative 1977 income

Table 4. Characteristics of 1975-78 Migrants to the South and the West Compared with the U.S. 1978 Population

Characteristics	U.S. population	Interregional migrants to South	Interregional migrants to West
Age			
% under 15	20.4	23.1	19.6
% 15-24	19.6	22.6	28.1
% 25-34	16.1	24.0	27.0
Median age	31.0	24.5	25.8
Sex			
% male	48.3	50.1	50.5
Race			
% white	86.8	89.3	87.8
Education			
% with upper education	30.1	45.4	52.4
% 1-3 years of college	16.1	18.3	21.8
% 4 years of college	8.5	14.0	15.8
% with graduate education	5.5	13.1	14.8
Occupation (males)			
% Professional, technical and kindred occupations	15.2	19.9	21.2
% Managerial and administrative	14.4	16.5	14.7
Relative income, 1977			
% above poverty level	88.7	87.4	85.5

Source: U.S. Bureau of the Census, "Geographical Mobility: March 1975 to March 1978," *Current Population Reports*, Series P-20, No. 331, November 1978, Tables 5, 6, 24, 28, and 40.

for the two migrant samples goes against our expectation of higher income levels for migrants into the two regions of the Sunbelt states. Percentages of migrants above poverty level in the stream to the South (87.4 percent) and in that to the West (85.5 percent) were *lower* than for the total U.S. population (88.7 percent). While not large, these differences are certainly contrary from what might be predicted. They could well reflect Larry Long's recent finding that, since about 1975, the historic outflow of the poor from the South has also reversed direction. However, the shift to net in-migration of persons below the officially defined powerty level is due more to a drop in poor out-migrants than an increase in poor in-migrants, according to Long. He also finds that the West has had net in-migration of the poor since 1967.[54]

Except for income, then, recent migrants to the South and West do indeed appear to be "positively" selected. Since the Sunbelt states have captured the major share of the industrial development that has spawned the jobs which, along with the climate and lifestyle, have probably been the chief attractions for recent migrants to these two regions, it could well be that data on the characteristics of Sunbelt in-migrants strictly speaking would show still more positive selection. The proportion of blacks in the migrant streams to the two regions between 1975 and 1978 was in line with recent Census Bureau survey data.

Migration selectivity among the elderly may be even more important than that for migration in general for states like Florida, California, and Arizona where such a large segment of migrants are in the retirement years. The most current set of data on elderly migrants is again that for 1965-70 from the 1970 census. The characteristics of elderly migrants to the Sunbelt may since have changed, but we can see how they compare in general with those of the elderly already living in the Sunbelt. A recent study of these data for persons aged 60 and over found Sunbelt migrants (both into and between Sunbelt states) little different from Sunbelt nonmigrants in age and sex distribution, but there were fewer blacks than might be expected among migrants.[55] Migrants ranked higher on income and education and lived in newer and better quality housing than nonmigrants.

Elderly Sunbelt migrants also proved to be more highly selected than migrants who moved to or within the Snowbelt between 1965 and 1970. They were relatively younger, included more married couples, and again ranked higher on personal income and education and lived in newer, higher quality housing than their counterparts in the Snowbelt.

From Lee's viewpoint of positive migration selection, the Sunbelt states are indeed fortunate in the quality of the newcomers they have received. Except for income level where the evidence is not conclusive, Sunbelt migrants in the mid-1970s were most likely selected from the younger and better qualified segments of the population. Evidence from 1965-70 also suggests that elderly Sunbelt migrants are of higher status than others of their age among both current Sunbelt residents and migrants into and between Snowbelt states. From this alone one might expect the new migration to have had a positive impact on the Sunbelt socioeconomically. But what other effects have the migration of Snowbelt residents to the Sunbelt had on the political, environmental, economic, and cultural dimensions of Sunbelt living?

Consequences of the Sunbelt Migration

Economic consequences

The Sunning of America—the migration to the Sunbelt and its concomitant industrial development—have helped reduce a longtime economic gap. The regions that make up the Sunbelt and the Snowbelt are becoming more alike and sharing the nation's wealth more equally. The Southeast, the Southwest, and the Far West have all increased their shares of the nation's total personal income. At the same time, New England, the mid-Atlantic area, the Great Lakes, and Great Plains states have had decreasing shares. In 1940, for example, the mid-Atlantic states had 30.5 percent of U.S. personal income; the Southeast had 13.2 percent. In 1977, however, the mid-Atlantic figure was down to 21.3 percent while the Southeast's share rose to 19.4 percent.[56] Oklahoma, with accelerated growth after 1970, showed a 63 percent increase in personal income in the next five years—from $8.7 billion in 1970 to $14.2 billion in 1975—while the U.S. increase was 55.6 percent. The state's per capita income rose from about 85 percent of the national average to 89 percent in these five years.

The South as a whole made important income gains during the migration turnaround decade of the 1960s. Its per capita income rose from 79 percent of the national average in 1960 to 86 percent in 1970 and was up to 90 percent by 1976. If this accelerated gain keeps up, Long sees the South's per capita income reaching 93 percent of the national average by 1980.[57]

Even with this rapid closing of the gap, however, Long notes that in 1977 the South still had more than twice as many people below poverty level as the Northeast—10.4 million, or 15.2 percent of its population, compared to 4.9 million (10.2 percent) in the Northeast. In the West, poor people numbered 4.0 million in 1977, 10.5 percent of the region's population. We cannot be sure until the 1980 census what proportion of that poverty lies in the Sunbelt states. However if Texas is typical, the other 14 Sunbelt states have their share. With a billion dollar surplus in its state treasury at the end of 1977, Texas still had a fifth of its 12.8 million residents surviving at or below the poverty line. The state ranks 39th in per capita expenditure for social welfare.[58] The poor have scarcely profited from Texas' industrial boom.

The rise of the Sunbelt has also lowered unemployment. The jobs added with the industrial expansion in the Sunbelt states which experienced major population growth have dropped unemployment rates in those states below the national average. In March 1977 when national unemployment stood at 6.9 percent, Texas showed the lowest rate with 4.7 percent. Oklahoma (4.8 percent), Arkansas (6.2 percent) and North Carolina (5.2 percent) were also well below the national rate. Other Sunbelt states were still above that average. Mississippi (6.9 percent) and Louisiana (7.6 percent) were somewhat higher. California, still pulling out of its recession of the early 1970s, had about 700,000 people out of work (7.3 percent). Many of the unemployed are hard-core poor, lacking the skills to compete in the open job market. In 1975 more than 4,000 people—most of them black—were interviewed for employment at the Atlanta Urban League. Only 686 were placed in jobs. According to a local official, "The ratio is typical."[59]

The growing economic prosperity of the Sunbelt has laid the foundation for continuing growth and expansion of the industrial sector and, consequently, the population. Peter Morrison describes it this way:

> "Servicing the arriving migrants and temporary residents provides opportunities which induce existing residents to stay and which also entice more newcomers . . . The resulting population, larger and more affluent, enlarges local demand for goods and services, thereby creating new jobs for more migrants."[60]

Lawton, Oklahoma, for example, began the decade dependent upon Ft. Sill for the 6,000 jobs it furnished and a small Haggar slacks plant with 350 jobs. Goodyear moved in during the mid-1970s to add another 1,400 jobs. The Goodyear plant not only added $20 million in payroll but also generated approximately $8 million in retail trade and $7 million in bank deposits each year. Three new retail establishments and approximately 5,000 new people in jobs were brought about by that Goodyear payroll.[61] And other industries will probably follow on the heels of Goodyear.

The expanding economy and growing population of the South, the Southwest, and the Far West—and, no doubt, the Sunbelt, even more—have brought these areas closer to the economic status of the country as a whole, although the poor and the unemployed are still there. With further migration likely as industry and its spinoffs keep on expanding, the prospects for upgrading of these economies looks bright.

Political consequences

Along with changing economies have come changes in the political realm. The Snowbelt migration to the Sunbelt has brought returning Southerners and Northerners alike. Many returning Southerners are politically active and are able to work within existing political structures. They bring back with them some of the new issues of other regions, particularly environmental concerns. Southern conservatism may soon give way to more liberal viewpoints from the North.[62] The growing numbers of Republican Senators and Representatives are already evidence of some erosion in the sway of the South's Old Guard Democrats: for example, the 1978 defeat in Mississippi of Democrat Maurice Dantin—Senator James O. Eastland's handpicked replacement—by Republican Thad Cochran.

The Sunbelt's rapid population growth at the expense of the Snowbelt will bring about a reapportionment of House of Representative seats, once the 1980 census returns are in, that promises significant changes in the nation's political power structure. As of January 1978, the Census Bureau expected nine House seats to be shifted. Six of these will be added to Sunbelt states: Arizona (1), California (1), Florida (2), and Texas (2). For the first time in history, the South and the West together will hold half the seats in the House (218). Census population projections for 1980 indicate that three or four more seats will shift if current growth trends continue. In that projection, it is likely that Florida will pick up an additional seat.[63]

Another important political consequence of the Sunbelt's rise is a probable shift in the thrust of federal funding from the South to the North. Long believes that once the North-South gap in income is closed Washington will have difficulty "justifying the New Deal programs which helped the region 'bootstrap' its way to a higher economic status."[64] There is some indication that community development programs have been tilted recently to favor older industrial cities of the North.[65]

Awareness of emerging economic and political power in the Sunbelt is accompanied by questions of what "fair share" regions are entitled to. One argument claims that Northern states have paid out more in federal taxes than they

CHECK YOUR WIPER BLADES?

Photo: Wm. C. Blizzard/UNIPHOTO

Servicing the migrants arriving to enjoy the Sunbelt's growing prosperity provides opportunities which induce existing residents to stay and which also entice more newcomers.

receive back in services and federal contracts while the Sunbelt enjoys the opposite. A recent study prepared for the Advisory Commission on Intergovernmental Relations, however, suggests that all U.S. regions are moving closer together in federal taxes paid and spending received. It notes, for example:

> "In 1952, the six New England states received only about 78 percent as much in federal expenditures as they paid the federal government in taxes; for the 1974-1976 period, their intake and outgo were almost exactly equal. On the other hand, the 12 Southeastern states, which in 1952 received about 50 percent more in federal funds than they paid out, found that margin reduced to only 11 percent in the latest period."[66]

The irony of the "fair share" argument is that for 40 years the nation has been trying to develop Western resources and bring the South up to parity with the North, and now that it seems to be occurring, "we're wringing our hands over it."[67]

Some are concerned that the debate over federal spending policies will lead to a new sectionalism. However, former Representative Michael J. Harrington, then chairman of the House Northeast-Midwest Economic Advancement Coalition, insisted in 1977 that the "second war between the states" has no credibility among political leaders in Washington or in any Northern state.[68] To pit region against region benefits neither the regions involved nor the nation as a whole; it merely consumes energy which might be devoted to the regional development which will make the question moot.

Consequences to the environment

> "Jack Douglas can't go rabbit hunting near his Florence, Alabama, home the way he used to. The fields are now covered with subdivisions. His favorite bass-fishing spot on nearby Wilson Lake is churned by water skiers all summer, and the fish don't bite anymore. The family-owned restaurant where he used to eat fresh-baked pies and spicy barbeque sold out to the Bonanza steak chain last year."[69]

The Sunbelt migration has also left its mark on the landscape. "Progress creates as many scars as it does beauty marks."[70] Rapid growth in metropolitan and many nonmetropolitan counties has pushed back the perimeters of rural leisuretime privilege. Jack Douglas was one victim of a "scar"—urban sprawl in Alabama.

Breakneck growth is overwhelming the capacities of many Sunbelt cities to cope with demands for facilities and services and threats to the environment.

Consider Killeen-Temple, Texas, one of the 15 fastest growing U.S. metropolitan areas between 1970 and 1975 (31.7 percent). The twin cities push out relentlessly as new developments spring up "like dandelions. And development, like dandelions, tends to get out of hand." A ten-year master plan was abandoned soon after its inception. The cities grew beyond the plan's most distant image within five years. Traffic congestion gets worse every year, sewer and water systems are taxed beyond capacity, housing prices are soaring, and suburban sprawl is threatening many small outlying communities.[71]

Or take Houston, Texas, now the country's fifth largest city, where an average 2,000 cars were added each week between 1975 and 1978. Vehicle registrations escalated from 418,293 to 1,771,776 in just three years. The last major freeway construction was in 1973. The one-and-a-half hour rush period of 1975 has now stretched to two-and-a-half hours. Houston planners believe that traffic problems have slowed the growth of office locations. Downtown firms now provide parking permits and fleets of van pools to encourage secretaries to continue on the job. Of even greater concern is air pollution. Houston is aware that, unless auto exhaust emissions are reduced, federal officials

Photo: Michael von Helms/UNIPHOTO

Breakneck population growth added 2,000 cars a week to the freeways of Houston, Texas, between 1975 and 1978.

will insist that new refineries and petrochemical plants locate elsewhere (and take their jobs with them).[72] Traffic congestion in Atlanta has forced a plan to widen some four-lane expressways to ten lanes. Rapid growth in Fort Worth has inflated the housing market so that a $30,000 house of the early 1970s now sells for $50,000.

Added to the problems of rapid growth, where meticulous long-range planning yields to crisis bandaid strategies, are the problems of the distribution of people and industry within metropolitan areas. In the past, Sunbelt cities of the South were typically commercial, with service hinterlands tucked close in to city boundaries. Rich and poor, black and white lived in close proximity in residential areas surrounding the business center. Even in the 1960s, Southern metropolitan areas showed lower levels of socioeconomic and racial housing segregation than metropolitan areas of other regions.[73]

By 1970, however, segregation between the central city and the suburbs was well under way. Suburbs attracted more of the new white in-migrants than central cities did and white middle class households began moving from central cities to the suburbs. Between 1960 and 1970, the percent of white population living in Southern central cities declined 25 percent; the black central city population increased about 1 percent.[74] Since 1970, the decline in the South's central city population has averaged an annual 6,000 persons. Many of these are moving to the predominantly white suburbs outside city boundaries. In 1977, the demolition of city housing outpaced new construction. Atlanta's central city now contains almost three-fourths (72 percent) of the black residents of the seven-county metropolitan area.[75]

The central city-suburban imbalance of blacks may now be changing. Census Bureau data show that between 1975 and 1977 black moves into suburbs around the country accounted for 14 percent of the net suburban growth due to migration, compared with just 7 percent between 1970 and 1975. Further, suburban blacks increased by 34 percent over the first seven years of the decade, although they still make up only 6 percent of total suburban population.[76] While these are national trends, it is likely that they represent patterns in Sunbelt cities as well.

Industry has followed the shift of more privileged ranks of population to the perimeter of Southern metropolitan areas. A recent study of industrial growth in the Fort Worth-Dallas area illustrates this trend. Established firms entering the area now locate their branch plants in the suburbs and nonmetropolitan areas adjacent to the suburbs more often than in the two central cities. New firms tend to locate within the cities but are expected to join the trek to the suburbs as they become established and can furnish their own support services. Typically, as soon as new firms have established production records, they are lost to the two central cities' tax base.[77]

Because most Sunbelt migrants to metropolitan areas choose the suburbs, commercial and retail activities have suburbanized as well. Recent new office space has been constructed primarily in suburban areas of both the South and the North.[78] The Sunbelt shopping center has also followed the population deconcentration, as in other areas, fed by new beltways around and through the city proper.

The growth of Sunbelt metropolitan areas in the last two decades has focused on suburbs and close-in nonmetropolitan counties. If this growth continues to attract the better off and better educated from among both Sunbelt in-migrants and existing central city populations, the once less-segregated Sunbelt cities may soon develop the pattern of the poor black hole within the surrounding affluent white doughnut now typical of deteriorating cities of the North.

One Southern economist, Frank Breckenfeld, claims that Atlanta and New Orleans already exhibit the symptoms of doughnut cities. Atlanta, which now has a majority of blacks in the central city, finds itself with a "glut [perhaps temporary] of new hotel space, vacant offices, condominiums and apartments." New Orleans has experienced decline for two decades despite the fact that it has a "flourishing tourist trade and the nation's second busiest port [after New York]." New Orleans' large number of unskilled workers has inflated the ranks of discouraged workers—those who want to work but have given up looking for a job.[79]

What are the implications of this growth pattern for Sunbelt cities?

The loss of upper income families means a loss of wealth and a shrinking tax base for the central city as does the flight of industrial, commercial, and retail establishments. Meanwhile, the concentration of low-income disadvantaged population in the central city calls for larger outlays for police protection against victimization and fire protection against the hazards of vulnerable, dilapidated housing. Thus suburbanization of Sunbelt metropolitan areas means rising costs of central city services at the same time that the central city tax base is shrinking.

The doughnut pattern is also expensive in terms of energy. Longer trips to work and to the central city for services put undue burdens on energy supply. The automotive age has caught up with the Sunbelt along with Snowbelt growth patterns. Current consumption patterns give no indication that increasing the cost of energy reduces the amount used by the American driver. The surge of nonmetropolitan growth may tax natural energy sources even more than the suburbanization of the past two decades.

Finally, whether in the central city, the suburb, or nonmetropolitan areas of the Sunbelt states, the arrival of large

Photo Bell & Stanton, Inc., Atlanta

Atlanta, Georgia, has mushroomed along with the Sunbelt boom but now exhibits the possible symptoms of a "doughnut" city, with a black majority in the central city surrounded by affluent white suburbs.

numbers of elderly migrants means that retirement communities will soon place additional demands upon the recreational, social, and medical services of Sunbelt cities. Even though these migrants appear to be drawn from the more privileged of the nation's elderly, they will inevitably need more support services as they age. Thus, while the short-range impact of their arrival has been a healthy boom in retail and housing sales, the long-range impact will be a strain on the communities to which they have moved.

The Sunning of America

The Sunbelt has indeed become a major destination for migrants within the United States. This is true for migrants of all ages, but especially for the elderly. Three Sunbelt states attract particularly large flows of migrants over long distances from Snowbelt states spread across the nation: California, Arizona, and Florida. Five others are the focus of heavy in-migration from areas nearer by: Texas, Oklahoma, Arkansas, Missouri, and Virginia. Because these migrants in general and the elderly among them are better qualified and more privileged than average, the socioeconomic characteristics of the Sunbelt population as a whole are now nearly up to national averages.

This growth and development has been a mixed blessing, however. Equalization of the regions has raised questions of possible new sectionalism. Now that the Sunbelt has risen, Northern mayors are asking, "Will the Snowbelt rise again?" Competition for federal dollars may pit region against region, to the disadvantage of all. Current growth in the Sunbelt may bring other problems. Suburbanization of industry and population has segregated the rich and the poor so that central cities in the South may soon face the many problems now stultifying the decaying cities of the North. The Sunbelt may also soon be confronted with increased demands for services for the very old as the growing numbers of retirees age still further.

The outlook for the Sunbelt's future depends to a large degree on whether or not public planners will heed the signals of emerging problems in time to avoid the pitfalls of laissez-faire growth. It would be irony indeed if the Sunbelt after 40 years of struggle to overcome its dependent status should "sow the seeds of its own decay in its traditional conservative reluctance for active government to provide mass transit, better schools, better city planning, more services to concentrations of minority groups."[80]

After almost a decade of record growth, there is some indication that in-migration has slowed in several Sunbelt states. In 1977, Florida's annual growth dropped to about a third of what it was earlier in the decade. Arizona's growth rate of about 5 percent a year until 1975 slowed to about 2 percent in the following two years. On the other hand, growth rates increased in Texas and Oklahoma. And Louisiana—the last Sunbelt state to achieve net in-migration—finally did so in 1977. California, whose growth tapered off in the early 1970s, appeared to be growing at a faster rate after 1975.[81]

The most recent Census Bureau projections (which assume continuation of 1970 fertility and mortality levels and interstate migration rates of the 1970 to 1975 period), estimate that the population of the 15 Sunbelt states will reach nearly 90 million by 1980, or 39.9 percent of the total U.S. population—up from 85 million, although about the same percentage share as in 1970. By the year 2000, if the growth pattern of the 1970s continues, the Sunbelt will reach 112 million and will comprise 43.2 percent of the nation's population. The South and West combined will have almost 150 million residents and account for well over half (56 percent) of the U.S. population.

As long as this growth continues, the Sunbelt will, no doubt, continue to prosper. The challenge for planners is to direct that growth in such a way that the Sunbelt states can continue to provide the quality of living which the new migrants seek to enjoy. ☐

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Frustrated Fertility: A Population Paradox

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Frustrated Fertility: A Population Paradox

By Joseph A. McFalls, Jr.

Abstract—This *Bulletin* examines the causes of subfecundity—the diminished ability to reproduce—and its effect today and in the past on the fertility, or actual reproductive performance, of individuals and, hence, populations. By definition, all real populations are subfecund since all experience some degree of involuntary biological factors affecting coitus, conception, or the ability to carry a conceptus to a live birth which reduces their fecundity below the estimated biological population maximum of 15 children per woman. Affecting both men and women, these factors fall into five categories: genetic factors such as blood group incompatibilities and inherited sickle cell anemia or diabetes; psychopathology, including psychic stress and behavioral disorders (e.g., drug and alcohol abuse); infectious diseases such as gonorrhea, malaria, tuberculosis, and post-abortion infection; malnutrition, including the chronic undernutrition of the Third World and the overnutrition of developed societies; and hazards posed by increasing amounts of radiation and toxic chemicals in the environment. Reducing subfecundity requires improved living conditions, avoidance of or protection against known hazards, and adoption of medical advances which now can help 40 to 60 percent of subfecund couples. Eliminating subfecundity would affect fertility most in non-contracepting societies, particularly the band of Central African countries where involuntary childlessness now ranges up to 50 percent. But even in the U.S., fertility would certainly rise among the 15 percent of couples now estimated to be involuntarily childless and the 10 percent who have fewer children than they want, and among disadvantaged groups, and teenagers.

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Photo Wide World

Louise Brown, born July 25, 1978, in Oldham, England, was the world's first baby to be born after being conceived in a laboratory outside her mother's body. Medical advances can now help 40 to 60 percent of couples who have trouble producing the children they want, but reducing subfecundity also requires tackling such conditions as infectious disease, poor nutrition, psychic stress, and environmental hazards which contribute to its widespread prevalence around the world.

Frustrated Fertility: A Population Paradox

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On July 25, 1978, in Oldham, England, a baby girl, Louise, was born to Gilbert and Lesley Brown. The birth was announced in headlines throughout the world and reporters pressed in on the small hospital to get pictures of Louise and statements from her parents. The reason for this extraordinary interest in the birth of one child was that Louise Brown was the first baby in history to be conceived outside her mother's body. Lesley Brown, unable to conceive because her fallopian tubes are missing, underwent a simple operation to remove several ripened eggs from her ovary. These eggs were fertilized in a laboratory dish with a preparation of her husband's sperm and, after several stages of cell division, a suitable embryo was implanted in Mrs. Brown's uterus. Louise was born by Cesarean section 37 weeks later, premature but evidently healthy and normal.

For this brief period the world's attention was diverted from the more familiar demographic topic of runaway population growth to a rarely discussed problem which nonetheless affects a sizable minority of the world's population—subfecundity. Subfecundity is any level of reproductive ability which is less than maximum. For the Browns and millions of other couples it is a curse that prevents them from having a child or the number of children they desire. But for a substantial minority of the world's population it is a blessing in that it limits the number of unwanted births. Thus subfecundity has a significant impact on the fertility of many individuals, and hence on population fertility.

This *Bulletin* considers the effect of population subfecundity on the fertility of present and historical societies and examines some of its more important causes. But first it is necessary to clarify important terminology and expand on what is meant by subfecundity.

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Defining Subfecundity

Fecundity is used here to mean reproductive ability as opposed to **fertility** which denotes actual childbearing. **Subfecundity** refers to the diminished capacity to reproduce. The most severe form of subfecundity is **infecundity,** the total inability to reproduce both presently and in the future. Infecundity may develop in an individual who in the past was fecund and perhaps even had children. A **subfecundity factor** refers to a cause of subfecundity such as disease or psychic stress.

Subfecundity results from impairment of any of the biological aspects of reproduction—coitus, conception, and the ability to carry a conceptus to a live birth. **Coital inability** is defined as the inability to perform normal heterosexual intercourse. It afflicts both men and women, especially the former, and can be chronic or temporary. **Infertility** is defined as the diminished ability to conceive or to bring about conception. Thus infertility refers here only to conceptive difficulties, although the term has been used elsewhere to cover pregnancy loss and even coital problems as well. **Sterility** is the *complete* inability to conceive or bring about conception. It is simply the lowest point on the infertility continuum. Infertility is an important cause of subfecundity in both men and women, and like coital inability, can be chronic or temporary. Finally, **pregnancy loss** refers to the involuntary termination of a pregnancy before a live birth. It includes spontaneous abortion (miscarriage), late fetal death, and stillbirth, but not induced abortion or neonatal mortality (death in the first four weeks of life). While primarily a form of female subfecundity, pregnancy loss is partly due to defective sperm and thus is also a form of male subfecundity. **Perinatal mortality,** a joint term for late fetal mortality and neonatal mortality, is also discussed with respect to the findings of studies which do not differentiate between these two components.

Although both men and women can be subfecund, most specialists in this field prefer to focus on the couple because the couple's subfecundity is frequently the result of several defects, often minor, in both partners. Also, two otherwise fecund individuals may form a subfecund couple due to various biological incompatibilities. A woman, for instance, may produce antibodies against her partner's sperm. Napoleon and Josephine were a classic case of such "situational subfecundity"; both were fertile with another mate but were unable to have children together.

A population's fecundity is the average fecundity of its individual members. Individual fecundity varies widely. Some individuals are unable to have children throughout their lives. Others are superfecund, the world record for fecundity (and fertility) being held by a 19th century Russian woman who reputedly produced 69 children in 27 pregnancies. Although this claim is suspect, there is no doubt that some women have given birth to more than 30 children. Raymond Pearl, for instance, mentions one woman who had 32 children by age 40.[1] Thus individual fecundity varies from zero to more than 30 children. Maximum population fecundity falls somewhere between these extremes. It is impossible to calculate actual population fecundity, but by splicing together the highest age-specific fertility rates on record and considering other hypothetical models, most authorities estimate maximum population fecundity to be about 15 children per woman.[2] In other words, a population of women who engaged in regular sexual intercourse from menarche to menopause without using any form of birth control would, under the most favorable reproductive circumstances, average about 15 children per woman. A population is subfecund to the extent that it is biologically incapable of achieving this roughly estimated average. Since no population enjoys completely favorable reproductive circumstances, some causes of subfecundity are present in all real populations, and hence all are subfecund according to this definition. It is their relative ability to achieve this standard, however, that is pertinent here and of demographic significance.

The actual fertility of almost all populations ranges from one to eight children per woman, with about four being the worldwide average in 1978. Of course, subfecundity accounts for only some of the difference between this performance and the 15-child estimate of maximum fecundity. As demographers Kingsley Davis and Judith Blake pointed out in a classic article,[3] besides subfecundity, a society's fertility level is also determined by various forms of birth control and by the fact that much of individuals' reproductive period is spent without regular coital activity. One of the basic tasks of fertility studies is to determine the relative impact of these subfecundity, birth control, and "mate exposure" factors which Davis and Blake characterize as "intermediate variables."

Population subfecundity varies widely between populations due to substantial differences in rates of coital inability, conceptive failure, and pregnancy loss, and the length of time between puberty and the climacteric in men and between menarche and menopause in women. The average length of the reproductive period, for instance, is greater in developed than in developing societies. Subfecundity also varies over time for a given population. German women at the turn of the century, for example, had a reproductive span ten years shorter than today's. On the average, they now reach childbearing age (menarche) at 12 and leave with menopause at age 52; 75 years ago, their reproductive lifetime stretched only from ages 15 to 45.

The relative contribution of male and female disorders to subfecundity differences between populations and over time is also highly variable. This is difficult to pinpoint because men's reluctance to admit responsibility for a couple's subfecundity, particularly in developing societies, means less is known about the prevalence of male subfecundity. However, experts estimate that male subfecundity accounts in whole or in part for from 20 to 60 percent of the subfecundity in various populations. In the U.S., the consensus is that men contribute to subfecundity in 30 to 40 percent of cases and women, in 60 to 70 percent.

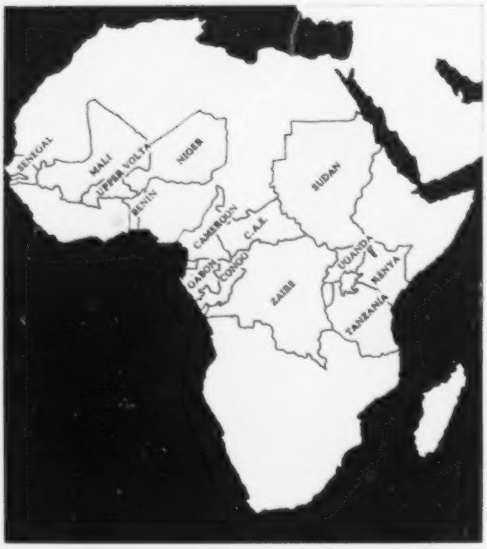
Effect of Subfecundity on Fertility

That subfecundity is one of the major determinants of population fertility is not just deduction. Statistics reveal that it is true of all populations, even of the group thought to be reproducing closest to the maximum rate—the Hutterites, a small religious sect scattered through the Dakotas and Montana in the U.S. and the prairie provinces of Canada. Their increasing fertility from generation to generation during the first half of this century was partly due to concomitant improvements in health conditions which affect fecundity. The power of subfecundity to affect fertility is most vividly seen in essentially non-contracepting societies with unexpectedly low fertility. These populations frequently reveal extraordinarily high rates of subfecundity. Africa presents a flagrant example of this today. In parts of Gabon, Cameroon, Zaire, the Central African Empire, the Sudan, and elsewhere across Central Africa, 20 to 50 percent of women aged 50 and older have never borne children, and subfecundity is recognized as an acute problem (see map on the next page, Figure 1).

Importance in historical societies

Subfecundity has doubtless depressed fertility since the human race began

Figure 1. Subfecundity in Africa



In parts of the African countries identified on this map, 20 to 50 percent of women aged 50 and older are childless, due mainly to high rates of infectious disease.

Source: Iain, Guest, "Infertility in Africa," Special Report, *People*, Vol. 5, No. 1 (London: International Planned Parenthood Federation, 1978) p. 23. Reproduced with permission.

about one million years ago. During most of this time, the rate of population growth was scarcely above zero. For such a low growth rate to be sustained, fertility and mortality had to be roughly the same. Experts conclude that for much of world history, average life expectancy was about 20 years. To offset this mortality, women would have had to average six to seven children, that is, substantially less than the biological maximum. Birth control and "mate exposure" variables probably accounted for much of this "fertility deficit," but subfecundity undoubtedly also played an important role in curtailing fertility and holding down population growth. Indeed, Rose Frisch suggests that subfecundity may be even more important in pre-modern societies than is usually assumed, for it could also be responsible for some of the shortfall usually credited to the other factors, especially traditional forms of birth control such as abstinence and prolonged breastfeeding.[4]

Population history prior to the 18th century can be divided into two periods, one extending back to about 8000 B.C. when agriculture was introduced and the other from 8000 B.C. to the beginning of mankind. Subfecundity influenced fertility in both periods although the leading causes were probably different. Subfecundity in historical preagricultural societies may have been similar to that observed among some contemporary hunting and gathering societies. The Kung tribe of Africa's Kalahari Desert, for instance, has moderate fertility with relatively long intervals between births. This may be partly due to poor nutrition and low body weight which reduce fecundity, conditions that may have also been common in historical preagricultural societies. The village life of the agriculturalists, on the other hand, brought comparatively many individuals close together, facilitating the spread of many diseases which cause subfecundity. Also, by relying more on crops for survival, agriculturalists became more vulnerable to crop failure which led to unpredictable and catastrophic famines and the gross malnutrition that is a potent cause of subfecundity. Thus, chronic undernutrition may have been a relatively more important cause of subfecundity in the preagricultural period, and disease and starvation may have been relatively more potent in the agricultural period.[5]

This capsule description of population history glosses over the short-term variations that occurred in growth, death, and birth rates in many societies. Subfecundity also fluctuated with the ups and downs of food supply and disease.

One disease that may have had a significant impact on the fecundity and fertility of numerous historical populations is tuberculosis. Evidences of this venerable disease have been found in the skeletons of prehistoric men. It is probable that in Eurasia after 500 A.D. tuberculosis affected mortality, fecundity, and fertility as much as or more than smallpox or plague. Tuberculosis was very prevalent in Europe prior to the 20th century and may have been a significant cause of subfecundity there.[6] It has also been suggested as a prime cause of subfecundity among U.S. blacks during the latter half of the 19th and early 20th centuries.[7] Smallpox is another disease that may have considerably reduced fecundity and thus fertility, as Peter Razzell feels it did in Britain before 1850.[8] Sudden declines in the prevalence of such subfecundity-producing diseases as tuberculosis and smallpox are often accompanied by a rise in fertility as happened in Europe during the 19th century or more recently in parts of the Third World.[9]

Importance in developing societies today

Today subfecundity affects fertility more in developing than in developed societies. This is primarily due to two situations. First, in developing societies there are fewer social checks on fertility such as effective contraception and thus more fertility potential for subfecundity to negate. Second, these societies are far more exposed to powerful causes of subfecundity, particularly disease and malnutrition. This situation is compounded (and perpetuated) by the relative absence of quality health care and facilities.

Just how poor health care is in parts of many developing nations is graphically summarized in the following description written in 1974 of a health facility near Lagos, Nigeria, where one of the few known Americans to contract Lassa fever laid over while awaiting travel accommodations to the U.S.:

> "The Pest House was a crumbling building set aside for contagious diseases, with rough plaster walls and the inevitable corrugated tin roof. . . . There were no fans or screens. . . . The room was dimly lit and suffocatingly hot. . . . Within minutes she became aware of the mosquitoes; hoards of them coming in through the open windows. The small sink was black with them, and with flies. There were no nets on the beds. . . . As she got into bed . . . she saw the bedbugs, wingless blood-sucking insects with a faint acrid odor. . . . A rat scurried across the floor, darted erratically back and forth, then disappeared. . . ."[10]

Bad as these conditions are, almost one billion of the earth's inhabitants, most of whom live in developing societies, still have no access to any health care at all. Rampant, untreated disease is probably the most important reason for the subfecundity which afflicts such developing societies as the band of Central African countries with unexpectedly low fertility and high proportions of childless women.

Subfecundity can have a significant effect even on the fertility of developing societies thought to have excessively high fertility. For instance, the married Yoruba women in Ibadan City, Nigeria, average about six children per woman. Yet, by age 45, 8 percent are involuntarily childless and another 25 percent have had less than four live births in a society where four or more living children is considered the ideal.[11] If this apparent subfecundity were not present, the already high fertility of the whole population would rise materially.

Importance in developed societies today

Although not as virulent or as prevalent as in developing societies, subfecundity factors are still demographically important in developed societies. Indeed, despite the fact that the major U.S. fertility surveys of the last several decades have tended to omit subfecund women, they still found extraordinarily high rates of subfecundity among their respondents. About one-third of the married white couples of reproductive age surveyed in the 1941 Indianapolis Study[12] and in the 1955 and 1960 Growth of American Families Studies[13] were considered subfecund. Sociologist Carl Harter also classified 33 percent of a New Orleans sample as subfecund.[14] Coital inability is particularly rife in developed societies. Sex researchers Masters and Johnson estimate—conservatively, they say—that half of U.S. couples experience sexual dysfunction sometime during their lives.[15] This seems confirmed by a recent study among white, well-educated, and happily married U.S. couples, in which a startling 40 percent of the men reported difficulties with erection or ejaculation and 63 percent of the women admitted some form of sexual dysfunction.[16]

There is reason to believe that subfecundity is on the rise in developed societies. One factor is the dramatic increase in venereal disease which can seriously damage reproductive potential. Another is the widespread use of the pill and the IUD which can also cause problems for a few women who later hope to bear children. But since the majority of couples choose low fertility and are able to attain it through birth control, the impact of subfecundity on fertility is not as substantial as it is in developing societies. However, it is still important.

If subfecundity were to be eliminated in developed societies, fertility would certainly rise. Involuntarily childless couples or those who have fewer children than desired due to subfecundity would increase their fertility. Since it is now estimated that 15 percent of U.S. couples are involuntarily childless and another 10 percent have fewer children than they want,[17] such an eventuality would have a substantial impact on U.S. fertility—without even considering increases in fertility among those other subfecund couples who do not want more children and for whom subfecundity is a blessing.

Moreover, within contracepting developed societies, there are often significant subgroups not practicing effective birth control whose fertility would rise if subfecundity were not present. In the U.S. such subgroups would include lower income whites and blacks as well as teenagers. Indeed, it could be that many subfecundity factors are disproportionately prevalent among such groups. As demographer Ronald Freedman notes:

> "Health conditions and poor nutrition may affect the fecundity of the whole society or may affect the lowest stratum with special force as a result of the operation of the economic distribution system."[18]

As in the developing societies, lack of medical care is also an important cause of subfecundity among the underprivileged in developed societies. Even in the U.S. with its relative abundance of medical professionals, medical care is spotty; it is unavailable on a regular basis, for instance, to 10 million underprivileged children.

Subfecundity can also affect the fertility of high-natality subgroups in developed societies. Take the Older Order Amish, for example, another high-fertility religious group in the U.S. Recent cohorts have completed childbearing with a mean family size of 7 compared to 2.7 for comparable national cohorts. The fertility of the Amish has been increasing over the last 100 years, and childlessness has been declining. In a fascinating forthcoming article, Julia Ericksen and her associates argue that this is chiefly due to reductions in subfecundity, noting the group's willingness to take advantage of modern medical technology as soon as it appears.[19] They also observe that while the Amish have 7 children on average, the number varies greatly between families, probably due mostly to subfecundity. Even in one sample of particularly high-fertility Amish women which happened to include no childless women they were able to classify 10 percent of the women as significantly subfecund using infertility criteria alone. These women finished childbearing with only 4.6 children on average compared to 9.4 for the sample as a whole. In short, the authors conclude that the extraordinarily high fertility of the Amish would have been still higher had subfecundity not existed.

Some might argue that most subfecund women in developed societies still have the number of children they want; it just takes them longer. In other words, subfecundity would not affect completed fertility. This position denies the reality that substantial fractions of ever-married women in developed societies are involuntarily and permanently childless and that large numbers with children can have no more. It also ignores the effect of the timing of fertility on completed family size. For example, many women in the U.S. are now postponing childbearing until their late twenties and early thirties. This gives them fewer years to achieve their desired fertility and also requires that they do so in the face of the lower fecundity characteristic of these years due to aging and accumulated subfecundity from causes such as disease. About the much-speculated-upon possibility that many U.S. women are about to try to have their quota of two children late in their reporductive careers, demographer Conrad Taeuber has commented:

> "It's a pretty cloudy crystal ball. If women have these two children, we're bound to see the number of births go up. . . . But there is some reason to believe that some women will be disappointed and find they can't have these children."[20]

Subfecundity can also have important *indirect* effects on population fertility. It may influence fertility behaviorally through others of the Davis-Blake intermediate variables, reducing, for instance, the chances of marrying or maintaining a stable sexual union.[21]

It can also indirectly affect population fertility by influencing the timing of early fertility. Most women are relatively subfecund until about age 17 and delays in early childbearing which sexually active adolescents might experience because of this could provide women with the opportunity to develop a lifestyle other than that of becoming the mother of a large family. Also, the presence of subfecundity during the early reproductive years can allow progress to be made toward learning effective birth control which would reduce unwanted fertility or give a woman time to consider what her reproductive goals really are and then attempt to stick by them.[22] The subfecundity produced by syphilis, for instance, can provide such a delay. Usually contracted early in reproductive life, syphilis causes high rates of pregnancy loss during the two years after first infection. However, even untreated syphilis has little effect on pregnancy outcome after this period so that a direct effect on completed fertility would be unlikely for couples with low or moderate family size desires. But the two-year respite during the peak reproductive years provided by the subfecundity gives a woman the opportunity to revise her reproductive goals.

Although not so important demographically, it is worth noting that sub-

Photo U.S. National Archives

An Old Order Amish farmer and his son. Completed families in this high-fertility religious group in the U.S. have 7 children on average compared to 2.7 for the U.S. as a whole.

fecundity can also affect fertility indirectly by influencing the timing of late fertility. Delays in second or later children can result in lower lifetime fertility. Subfecundity used to be responsible for a considerable proportion of two-family women—those who had children early, stopped childbearing for many years due to a variety of reasons including subfecundity, and then had other children who were far younger than the first group. Today, with the increased availability of induced abortion and better contraceptives, women more often forego the second family in favor of other lifestyles. If it were not for subfecundity in the middle years, many of these women, especially those who had not yet achieved their desired family size, might well have had additional children spaced close to the first set. Thus subfecundity, by altering when women are able to have their higher order children, may alter completed family size as well.

These indirect effects of subfecundity on fertility may now make the most difference in developed societies. But they were doubtless also important in historical societies and remain so in developing societies. For example, the subfecund wife cast out by a disappointed husband has been a familiar tragedy throughout history and still is in many developing societies today.

In sum, subfecundity can affect fertility directly and may also affect fertility indirectly by altering the timing of births or by acting through one of the other Davis-Blake "intermediate variables." Conversely, these intermediate variables, which have to do mostly with birth control and mate exposure, may themselves cause subfecundity and thus affect fertility in this way also. For example, Winnifred Cutler and her associates have uncovered evidence that later and less frequent intercourse is associated with subfecundity.[23] Understanding population fertility fully may take more knowledge about the complex interrelationships between subfecundity, birth control, and mate exposure. But it cannot be denied that subfecundity is a major determinant of population fertility in developed, developing, and historical societies.

Causes of Population Subfecundity

Population students know very little about the fundamental causes of subfecundity and tend to prefer concentrating on how to measure its effects. Demographers have made advances in understanding how subfecundity is evident in longer intervals between births, but there is not much research that goes beyond this to identify its fundamental causes and quantify their impact on fertility. One authority, Hansluwka, concludes:

> "The gaps in our knowledge are too large to permit the construction of a reasonably plausible model of the effects of health on fertility via fecundity."[24]

What knowledge does exist permits the causes of population subfecundity to be separated into five categories: genetic factors, psychopathology, disease, nutritional deficiencies, and environmental factors. To be included in one of these categories, a subfecundity factor must fulfill two criteria: it must be capable of depressing individual fecundity and it must be able to affect a substantial proportion of a population's potentially fecund members.

Following is a brief overview of the five categories and their relationship to population fecundity.

Genetic factors

In their study of the Old Order Amish, Ericksen and her colleagues suggest that genetic or inherited factors might have been responsible for some of the subfecundity which they found since subfecund couples tended to have subfecund parents. But this is a rare reference to a possible genetic impact on population fecundity (and fertility). Most fertility research has assumed that genetic fecundity is the same in all populations and, to judge from the Hutterites and other prolific groups, is at the high level of approximately 15 children per woman. This assumption makes sense since it is currently impossible to measure a population's genetic fecundity accurately and nongenetic factors are generally more important determinants of fecundity. But the assumption overlooks the fact that reproductive ability has a genetic component that can vary between individuals and thus presumably between populations. Some demographers do concede that some populations appear to be genetically more fecund than others but offer no explanations other than vague references to the super-fecund Hutterites having "bred out" their subfecund members.

However, specific genetic factors that can alter individual fecundity have been identified. For example, persons with many of the inherited anemias experience high rates of pregnancy loss. And two individuals with normal reproductive capacity may be subfecund as a couple because differences in their inherited ABO blood group antigens can result in fetal-maternal ABO incompatibility which brings on miscarriage. (An antigen is a substance capable of forming antibodies when introduced into the bloodstream.) Since the gene pool of one population is different from that of other populations, it is likely that genes that make up the pool, including those which are capable of influencing reproduction, will also vary between populations. Thus genetic factors can be a cause of fecundity differentials between populations.

Chromosome abnormalities. Perhaps the best-described genetic influences on fecundity are Klinefelter's syndrome in the male and Turner's syndrome in the female. Males with Klinefelter's syndrome are born with XXY sex chromosomes instead of the normal XY male sex chromosomes and females with Turner's syndrome have XO rather than the XX sex chromosomes of normal females. In both cases, affected persons are usually sterile since the male's testes or the female's ovaries scarcely exist. Klinefelter's syndrome affects about 1 in every 400 to 600 male babies, while Turner's syndrome turns up in a much rarer 1 in 5,000 female births.

Less dramatic variations in both sex and non-sex chromosomes have been pinpointed as significant factors in abnormally low sperm production which usually makes it impossible for the man to impregnate a woman. Chromosome abnormalities are also important in female infertility. They are detectable in 15 to 25 percent of women who fail to menstruate by age 18, which is called primary amenorrhea.

Length of reproductive life. A more subtle genetic influence on fecundity is aging. Studies show that human cells grown in the laboratory will divide about 50 times before dying; no matter how favorable the conditions, the cells are incapable of multiplying further. This suggests that an individual's maximum lifetime is programmed into his genes. It could be that heredity similarly influences the rate at which the human body ages and the timing of such milestones in reproductive life as menarche and menopause. There is some evidence for this. For example, age of menarche varies from girl to girl depending not only on environmental factors such as nutrition, but also on the age of menarche of the girl's mother. And the Abkhasians of Soviet Georgia in the U.S.S.R., many of whom live for 100 years or more, illustrate how reproductive life may be extended beyond "normal" limits in persons who enjoy remarkable longevity. Many of the men in this group remain potent long after the age of 70 and almost 14 percent of the women continue to menstruate after age 55. However, there are inadequate data to judge the role of genetic factors in Abkhasian longevity. Likewise, the notion that the Abkhasians' extended reproductive span is genetically-determined, though certainly plausible, is entirely speculative at present.

Sickle cell anemia. A surprising number of genetic factors related to the red blood cell pose serious threats to fecundity. Among these are the inherited anemias—sickle cell anemia and its cousins, sickle cell-hemoglobin C disease and sickle cell-beta thalassemia. In the U.S., sickle cell anemia is found almost exclusively among blacks. About 10 percent of U.S. blacks carry one S gene for sickle hemoglobin but only about 1 in 500 inherits the sickle hemoglobin gene from both parents and thus suffers from the disease. Such persons have SS hemoglobin in their red blood cells rather than normal AA hemoglobin. This bends the cells into an inflexible sickle-like, or new-moon shape, in contrast to the round shape of a normal red blood cell, which prevents the cells from moving easily through the blood system so that they clot painfully and destructively in body joints and organs and gradually lose the capacity to carry oxygen. So far there is no cure for the condition.

Sickle cell-C disease and sickle cell-beta thalassemia are rare anemias found almost exclusively in the tropics. They can seriously depress fecundity. Pregnancy loss has been reported at anywhere from 16 to 62 percent among women with sickle cell-C disease and up to 24 percent for those suffering from sickle cell-beta thalassemia.

For the relatively more common sickle cell anemia, pregnancy loss can reach an incredibly high 57 percent. Moreover, the anemia is often exacerbated by pregnancy and the risks of maternal death are significant. Males with the disease have been noted to have low sperm counts or hypogonadism, that is, reduced function or delayed growth of the testes which produce the sperm necessary to fertilize the egg produced by a female. Another possible complication is priapism, a persistent painful erection of the penis which makes coitus impossible; surgery to correct this often leaves the patient permanently impotent.

Without exemplary medical care, 20 to 40 percent of the victims of sickle cell anemia die before reaching reproductive age. Despite this weeding out, the S gene still persists and in fact is carried by about 30 percent of persons in the many parts of Africa where malaria is endemic. This is because persons with the sickle cell trait, that is, those persons with only one gene for sickle hemoglobin, AS, stand a better chance of surviving malaria than the normal AA genotypes—some 10 to 15 percent better even in the case of the most dangerous of malaria parasites, the *Plasmodium falciparum*.

Some experts believe that this well-known relatively greater chance of survival in malarious areas of the AS genotype is not the only explanation for the high rates of sickle cell anemia seen in some parts of Africa. Could it be that the AS genotype is also more fecund and thus more fertile? This may indeed be the case. In areas where malaria is hyperendemic, AS women have slightly higher birth rates than AA women and where malaria is relatively prevalent the rates are dramatically higher—nearly one and a half times higher in one study.[25]

AS males may also have a fecundity (and fertility) advantage in malarious areas. Where malaria is rife, even adults who have built up immunity from repeated bouts usually suffer the fever and chills of malaria twice a year. In normal AA men, each of these episodes is long and intense enough to impair sperm production for one to two months. For males with the AS blood type of sickle cell anemia, malarial fevers are shorter and less intense and sperm production is not affected. Thus, while the AA male is relatively infertile two to four months of the year, the fertility of the AS male is unaltered.

Any such fecundity (or fertility) advantage for the AS genotype disappears in non-malarious areas. In the U.S., for example, fertility histories are essentially the same for the 10 percent of black Americans who have the sickle cell trait and the vast majority who do not, with the exception of a suggested increase in rates of prematurity and low-birth-weight infants.

Red blood cell incompatibilities. In certain combinations, if a man and a woman are of different hereditary blood types, they may have trouble conceiving or the woman may suffer a miscarriage or stillbirth.

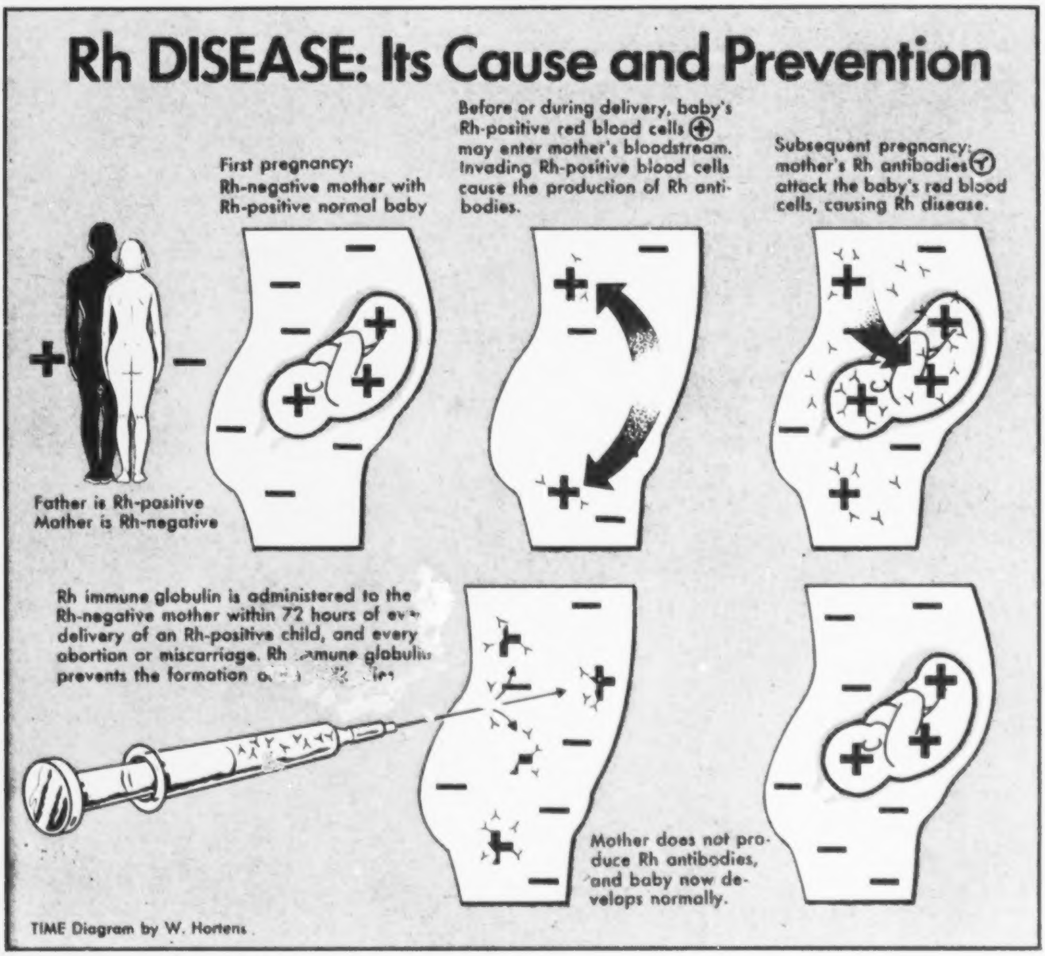
One such combination is called "ABO incompatability": the man has red blood cells which carry the blood group antigens A or B and the woman does not. Male sperm carrying the antigen may be attacked by antibodies in secretions in the woman's cervix which cause the sperm to clump together so that few or none can get through to the woman's fallopian tubes where they might fertilize the egg released when the woman ovulates. More often, however, ABO-incompatible matings result in an increase in pregnancy loss. If the fetus inherits from the father a blood group antigen that the mother does not have, antibodies against that antigen which the mother already has in her blood will enter into the fetus' bloodstream, destroy the fetus' red blood cells, and cause a spontaneous abortion. In fact, ABO incompatibility is seen in twice as many abortuses as would normally be expected. ABO-incompatibility occasionally results in stillbirths or neonatal deaths. But most of the mortality is very early in pregnancy, so early that a woman often does not realize that she has lost a pregnancy. Nevertheless, the effects on fecundity are substantial; completed family size in ABO-incompatible matings is half a child less than in compatible matings.

Males who inherit blood type A may have trouble impregnating any woman according to one study which found an excess of such blood types among a sample of infertile men, especially those with little or no sperm in their semen.[26]

The potentially harmful effects of Rh incompatibility on fecundity are much better known than those of ABO incompatibility because affected fetuses usually survive at least through a full-term pregnancy. About 85 percent of Caucasians carry the Rh (from rhesus monkeys who are all Rh positive) antigen on their red blood cells, that is, are Rh positive, compared to 93 percent of blacks and almost 100 percent of American Indians. Thus the "Rh factor" is a variable which can affect fecundity between populations.

The factor becomes a problem only when an Rh-negative woman who lacks the antigen is paired with an Rh-positive male—which is the case in about 12 percent of marriages in the U.S. Of the some 3.3 million births in the U.S. each year, about 260,000 result in the birth of an Rh-positive child to an Rh-negative mother. Some 10 percent of these 260,000 babies will suffer Rh disease to some degree.[27]

Unlike antibodies to the A and B blood group antigens which occur naturally, antibodies to the Rh antigen appear only after exposure to the antigen. If the mother is Rh negative and does not have the antigen, but her mate does (that is, he is Rh positive) and has passed the antigen to the fetus, the mother stands about a 10 percent chance of being exposed to the Rh antigen in the fetus' blood during her pregnancy. This risk falls to less than 5 percent if the pregnancy terminates early due to an abortion (spontaneous or induced). The first child is not threatened for the mother has not yet had time to become adequately "immunized" to the Rh antigen in the fetal blood and the level of antibodies against the Rh antigen is therefore low. But if an immunized mother subsequently conceives a second Rh-positive fetus her blood system, primed to react,


Rh DISEASE: Its Cause and Prevention
First pregnancy: Rh-negative mother with Rh-positive normal baby
Before or during delivery, baby's Rh-positive red blood cells ⊕ may enter mother's bloodstream. Invading Rh-positive blood cells cause the production of Rh antibodies.
Subsequent pregnancy: mother's Rh antibodies Ⓨ attack the baby's red blood cells, causing Rh disease.
+
−
Father is Rh-positive
Mother is Rh-negative
Rh immune globulin is administered to the Rh-negative mother within 72 hours of every delivery of an Rh-positive child, and every abortion or miscarriage. Rh immune globulin prevents the formation of [illegible]
Mother does not produce Rh antibodies, and baby now develops normally.
TIME Diagram by W. Hortens

This diagram illustrates the cause of Rh disease and the vaccination method now most commonly used to prevent it. Reprinted by permission from TIME, The Weekly Newsmagazine; Copyright 1973 Time Inc. All rights reserved.

quickly starts producing antibodies which mount an attack on the fetal red blood cells. The destruction may be so severe as to cause a stillbirth or the baby may be born too early to survive more than briefly. Those who do survive can be brain damaged and all suffer with severe anemia and a jaundice-like condition.

There are now effective ways to treat this problem: by blood transfusions for the baby, either before or after birth, or by vaccinating the Rh-negative mother with a globulin which stops the production of antibodies (see diagram).

Metabolic abnormalities. There are two inherited diseases affecting a person's metabolism (ability to absorb and utilize certain types of food) which can alter reproductive potential: glucose-6-phosphate dehydrogenase deficiency and diabetes. The first results from the deficiency of an enzyme (an important substance produced in living cells) and is probably the most common of all metabolic abnormalities. It is usually a benign disease and in itself has no effect, positive or negative, on reproductive potential. But when combined with sickle cell anemia it can be a blessing for fecundity. Sixty percent of Saudi Arabs have this deficiency disease. For those who also have sickle cell anemia, the anemia is relatively mild and the outcome of pregnancies is about the same as it is for the general population.

Diabetes, another common metabolic disease, is characterized by a deficiency in the supply of insulin secreted by the pancreas so that sugar (or glucose) in the diet is not broken down correctly. The result is a high level of sugar in the blood and urine. The condition can be controlled by diet, exercise, and regular injections of insulin, but not cured.

Diabetes significantly depresses fecundity but since it usually does not appear until after age 40, only a small proportion of the population will be affected during their reproductive years.

About 50 percent of diabetic men are impotent; this amounts to one million men in the U.S. alone. This impotence cannot be treated and is unlikely to correct itself.

Infertility is an important feature of diabetes. Before insulin was discovered in 1921 few diabetic women conceived; 50 percent were amenorrheic (had no menstrual bleeding) and another 15 percent had menstrual problems. Now, with insulin, diabetic woman have no trouble conceiving. However, diabetic men, even those treated with insulin, may develop problems with ejaculation and thus be unable to bring about conception.

Before the discovery of insulin, babies born to diabetic women suffered extremely high perinatal mortality rates. Though the rates fell steadily thereafter they remained quite high until the 1960s when diabetic pregnancies began to receive full medical supervision, at least in developed countries. Nevertheless, even with the best medical care, some 4 to 7 percent of babies carried by diabetic mothers die just before or after birth; under less favorable circumstances, the rate is much higher. Perinatal mortality rates are also a high 9 percent versus the normal 1 percent for mothers over 25 who are "gestational" diabetics, that is, diabetic only during pregnancy. (Many of these women will eventually develop full-blown diabetes.) Such women, however, make up only 2 to 4 percent of women having babies.

Given the reproductive problems which diabetics experience, how could diabetes persist at relatively high rates, especially in the days before insulin? It has been hypothesized that when food supplies are chronically short, as in the past and still today in some developing societies, persons who would develop overt diabetes in an environment of plenty might have an advantage. It has been noted, for example, that women with a hereditary tendency to diabetes begin to menstruate earlier and are more fertile. But when people with a tendency to diabetes begin to get more food, the disease develops and its negative aspects appear. Overt diabetes is becoming common in many parts of the world where rapid social change is being accompanied by substantial dietary change. Research among Kalahari Bushmen in Africa shows that their blood sugar levels are normal so long as they remain on their sparse native diet but reach levels which hint of diabetes when they are put on a high calorie diet. Diabetes is very common in Africa where social change in proceeding rapidly. In South Africa, rates among the tribal peoples still in their villages remain low, but are very high for those who have moved into the cities. When the changeover to a richer diet occurs in developing societies the genes for diabetes may be bred out if insulin is not available and the negative effects of the disease begin to outweigh its positive aspects. In the U.S., however, insulin is plentiful and its widespread use has ensured that diabetes is likely to become ever more common. The National Juvenile Diabetes Foundation has in fact estimated that, by 1980, one of every five Americans will be diabetic.

In sum, genetics can play a very important role in human reproductive potential. The hereditary anemias and metabolic anomalies can definitely influence fecundity, as can Rh incompatibility. But of the conditions noted here, ABO incompatibility appears to have the greatest potential as a fecundity depressor. Other more subtle, but potentially powerful, genetic influences which are not associated with a much studied entity such as blood group or manifested by serious disease such as diabetes will probably go unrecognized for some time. The science of genetics still has a long way to go before being able to identify all genes which influence reproductive ability and their frequency in human populations. Until then, population genetic fecundity will have to be measured by reproductive *performance* —specifically, that of the Hutterites —rather than reproductive *ability*, and possible variations in fecundity due to genetic factors will probably be disregarded.

Psychopathology

Many types of mental and behavioral disorders, or psychopathology, can lead to subfecundity by causing coital inability, infertility, and/or pregnancy loss. These include psychoses, sexual deviations, alcoholism, illicit drug abuse, cigarette smoking (a form of drug abuse classifiable as a personality disorder), and psychic stress (an amalgamation of neuroses, psychophysiologic disorders, and everyday stress).[28]

Currently, lack of data and other research problems make it impossible to measure the exact impact of psychopathology on population fecundity. Nevertheless, psychopathology is clearly an important cause of population subfecundity because it easily fulfills the two necessary and sufficient requisites: it can have a considerable impact on individual fecundity and can affect a substantial proportion of a population's potentially fecund members. In what follows, the impact of psychopathology on individual fecundity is reviewed first, followed by a discussion of its prevalence among the U.S. population of reproductive age and its effect on the fecundity of different types of populations and subpopulations.

Effect on individual fecundity

Four important aspects of the relationship between psychopathology and individual subfecundity deserve attention. The first, and most important, is that psychopathology can be involved in each of the three main components of subfecundity; it is a major cause of coital inability and of conceptive failure and pregnancy loss. In fact, psychopathology is the most important cause of coital inability, probably accounting for about 75 to 90 percent of cases. It is also the primary cause of sexual disorders that are involved in conceptive failure, such as premature ejaculation. Aside from sexual disorders, psychopathology has a whole arsenal of other mechanisms to bring about conceptive failure of which the most important is probably the frequently seen anovulatory amenorrhea (failure of a woman both to ovulate and menstruate). Psychopathology, especially psychic stress, may also be one of the main causes of pregnancy loss. And sizable proportions of alcoholic, smoking, or drug-addicted women continue their habits throughout pregnancy, seriously jeopardizing the health of their unborn child.

Understanding how psychopathology can depress fecundity is important to appreciating the powerful effects which mental disorders can have on the body. Psychopathology works through two basic mechanisms: the pharmacological and the psychosomatic. The first is not restricted to psychopathology, but simply describes physiological effects brought on by substances which a person ingests.

Naturally, a pharmacological mechanism is chiefly at work in psychopathology involving drug abuse. Two examples are the weakening of the sperm's capacity to fertilize caused by the toxic effect of alcohol on the sperm-making cells of the testis; and the higher rates of pregnancy loss experienced by smoking mothers due to nicotine-induced constriction of blood vessels, with a subsequent drop in oxygen levels in fetal tissue.

The psychosmatic mechanism through which psychopathology works to cause subfecundity is more elusive. This mechanism is operating when psychological phenomena alter the body's physiological processes. In the past, such a mechanism was considered unlikely, since psychological and physiological processes were believed to be separate and distinct. But today it is acknowledged that almost every psychological process has physiological expressions; blushing or perspiring are normal reactions to emotions, for example. But the psychosomatic mechanism involves pathological as well as normal physiological responses. Indeed, the field of psychosomatic medicine grew out of the realization that a very large percentage of human physical ailments are of mental origin. Headaches, neck pains, nausea, ulcers, mucous colitis, asthma, and allergies are just a few of the problems that are often caused by mental disorder rather than injury or disease. A sudden drop in the stock market or the termination of a love affair can exacerbate a latent peptic ulcer or reawaken a tuberculous lesion. And myriad health studies have shown that single, widowed, and divorced individuals are far more likely to fall prey to disease than the married, a demonstration of the power of social isolation and loneliness to bring about physical deterioration psychosomatically.

In the psychosomatic mechanism, the changes that accompany stress are set off and controlled by the brain and mediated by either the autonomic nervous system or the endocrine system. The autonomic nervous system is a division of the nervous system that sends electrical messages from the brain to certain organs, telling them to act in a prescribed manner. Responses brought on in this manner include contractions of the involuntary muscles that are found in most of the reproductive organs except the ovary and the testis (fallopian tubes, uterus, vagina, sperm ducts, penis, etc.), and secretory activity by the organs of secretion which are involved in the reproductive process (seminal vesicles, prostate, cervix, etc.). Thus, subfecundity may be caused by the muscular spasms that can occur in the sperm ducts of men under stress which can interfere with the sperm's motility and fertilizing capacity, or by the secretion in some stressed women of abnormal cervical mucus that is hostile

Photo: United Press International

Women who smoke cigarettes experience higher rates of pregnancy loss than women who do not. Smoking has increased considerably among U.S. women in recent decades and now amounts to 40 percent among those of reproductive age (15 to 44).

to sperm and thereby reduces the likelihood of conception.*

But the subfecundity effects which can be mediated by the autonomic nervous system are limited since the central organs of reproduction, the ovary in the female and testis in the male, are not directly responsive to nervous stimulation. Rather, as part of the endocrine system, they are stimulated by hormones from the master endocrine gland, the pituitary, a pea-sized organ located under the brain. Determining whether emotions could influence the pituitary thus became a central issue in psychosomatic subfecundity.

The link between the emotions (the brain) and the pituitary was discovered in the 1950s. In brief, higher brain centers stimulate an adjacent part of the brain called the hypothalamus, causing it to secrete chemical messages which are carried to the pituitary. The pituitary responds to these messages by releasing two hormones which activate the ovary and the testis—follicle stimulating hormone (FSH) and luteinizing hormone (LH).

In the female, FSH directs the growth each month of one of the many follicles in the ovary which contains an immature human egg. It also stimulates the follicle to produce estrogen, a hormone necessary for the maintenance of the accessory reproductive organs, such as the vagina, and the secondary sex characteristics (e.g., pubic hair). The other pituitary hormone, LH, initiates the ovulation process by which a now ripened egg bursts forth from the follicle. This follicle, though ruptured, is not functionless but instead temporarily produces a second female hormone essential to reproduction, progesterone. In the male, FSH and LH direct the testis in two important functions—the production of sperm and the production of testosterone, the male equivalent of estrogen, which maintains the accessory reproductive organs of the male (e.g., the seminal vesicles and the prostate) and his secondary sexual characteristics such as a beard and low voice.

Since the hypothalamus is the primary control site for the growth and function of the gonads (the female ovaries and the male testes), any interference with the workings of the hypothalamic-pituitary-gonadal axis can have vast repercussions on reproductive potential. Stress is capable of such interference. Under conditions of emotional stress, the functioning of the hypothalamus is altered and this ultimately affects the functioning of the ovary or the testis. Alterations in hypothalamic functioning may be responsible for the abnormal hormone levels observed in some homosexual men. And this mechanism may also play a role in the psychoses, since abnormalities in hormone levels and in the sperm-making process have been noted in schizophrenic men. But the mechanism is most frequently encountered in the neuroses, psychophysiological disorders, and everyday stress. Common examples are failures in the sperm-making and ovulation processes experienced by some stressed individuals and the cessation of menstruation associated with severe trauma, such as internment in concentration camps.

A second important facet of the relationship between psychopathology and individual fecundity is the fact that many forms of psychopathology tend to appear early in life and to persist for much of the reproductive period. This prolongation of both the disorder and any subsequent subfecundity is frequently bolstered by the tendency for psychopathology to go untreated or to be treated ineffectively.

Third, the ability of psychopathology to decrease fecundity is enhanced by

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*For a brief description of the organs and processes involved in human reproduction, see Sheldon J. Segal and Olivia Schieffelin Nordberg, "Fertility Regulation Technology: Status and Prospects," *Population Bulletin*, Vol. 31, No. 6 (Population Reference Bureau, 1977).

the tendency for one form of subfecundity-producing psychopathology to cause others. Psychic stress often underlies drug addiction, for instance, and homosexuality may lead to alcoholism. Also, the fecundity of one partner of a couple may be jeopardized when psychopathology exists in the other. This is particularly relevant to psychosexual disorders; impotence in the male can lead to vaginismus (painful spasms in the vagina) in the female; premature ejaculation to female frigidity, and so forth. Indeed, if the union remains intact, it is probable that psychopathology in one partner will alter the fecundity of both members of the union to some extent.

Fourth, it is also important to note that the effect of psychopathology on fecundity may be indirect. That is, psychopathology may be causally associated with other factors that are the direct cause of the subfecundity such as disease and malnutrition. For example, psychic stress can increase the incidence, duration, and severity of tuberculosis, an important cause of subfecundity. Also, homosexuality is often associated with venereal diseases that can limit or destroy reproductive potential. And illicit drug abuse frequently leads to another cause of subfecundity, malnutrition.

Thus, psychopathology ably fulfills the first requirement of a determinant of population subfecundity, that is, it is an important cause of individual subfecundity.

Prevalence

Psychopathology can also be relatively widespread among the members of a population during their reproductive ages, the second requisite of a population subfecundity factor. Estimates of the prevalence of subfecundity-producing psychopathology in the reproductive population of the U.S. can serve as a good illustration. The following estimated percentages refer to the U.S. population aged 15 to 44.

Although virtually the entire U.S. population experiences psychic stress periodically throughout their reproductive period, and indeed throughout their lifetime, only a fraction are chronically stressed. A preliminary report of the President's Commission on Mental Health found that at any given time one-fourth of the population is experiencing psychic stress that produces varying degrees of depression and anxiety. Approximately 1 to 2 percent of the population aged 15 to 44 is psychotic, and, if homosexuality is included, substantially more than 4 percent are sexual deviates. Alcoholism claims about 7 percent of men of this age and 3 to 5 percent of women. Nearly 50 percent of American men smoke cigarettes, as do 40 percent of women. And 10 to 15 percent of the population aged 15 to 44 regularly abuses illicit drugs.[29] Although these estimates are imprecise and are not additive, since the same individual may have more than one disorder, it is clear that the fecundity of a sizable fraction of the U.S. population of reproductive age is jeopardized by psychopathology.

Since psychopathological disorders that can cause subfecundity do not invariably do so, not all those at risk are affected. With the many unknowns, it is difficult to provide even an approximate estimate of the proportion of the U.S. population aged 15 to 44 which actually becomes subfecund due to psychopathology. However, after considerable study, it is this author's judgment that an exceedingly conservative estimate would be 15 to 20 percent.

Probably the most potent psychopathological causes of subfecundity in the U.S. and elsewhere are psychic stress, alcoholism, and illicit drug abuse. All three are prevalent and have a strong effect on both male and female fecundity. Other significant causes are cigarette smoking by women and sexual deviations among men.

Population variability

The prevalence of psychopathology in general and in its specific forms varies widely between populations, between subgroups within a population, and over time. The amount of psychopathology-induced subfecundity will thus vary accordingly.

It is generally agreed that psychopathology is substantially more prevalent in developed than in developing societies. Some researchers even suggest that in modern urban societies virtually everyone suffers from some form of psychopathology. Since fertility surveys repeatedly find that 30 to 40 percent of the U.S. reproductive population is subfecund despite excellent health care and relatively low rates of such subfecundity factors as disease and severe malnutrition, the possibility that psychopathology may account for a substantial portion of this subfecundity deserves serious consideration.

There is considerable disagreement concerning the prevalence of psychopathology in primitive and developing societies. Some believe it is common; others feel that it is rare. However, the consensus seems to be that, although the level of psychopathology is considerably lower than in developed societies, it is more common than was previously thought. Consequently, the amount of psychopathology-induced subfecundity is probably also greater than is generally accepted. The following statement by a World Health Organization committee is significant because it aligns itself with the view that psychological factors have a definite role to play in the fecundity of developing societies:

"Congential abnormalities of the female genital tract, endocrine factors, and *psychological* factors causing infertility and preg-

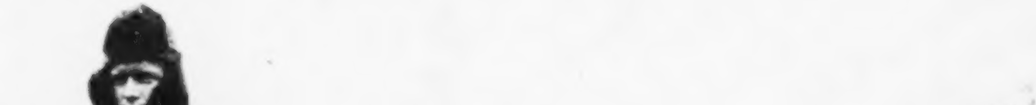


Photo: U.S. National Archives

Charles and Anne Morrow Lindbergh visit Eskimos of Point Barrow, Alaska, in 1931. The social dislocations caused by the intrusion of Western ways upon their simple hunting and fishing society have been followed by severe outbreaks of mental illness among the Eskimo.

nancy wastage are not discussed here since, although they represent some of the main causes of infertility, there is no evidence that they have any increased significance in Africa south of the Sahara"[emphasis added].[30]

In addition, many developing populations are in the process of modernizing, and the rapid sociocultural change and disorganization accompanying this process have led to increased psychopathology. This is particularly true in urban areas where the clash between traditional and modern cultures is sharpest. A recent example of this is provided by the Eskimos, among whom the social dislocations caused by the intrusion of Western ways upon their simple hunting and fishing society have been followed by a severe outbreak of mental illness. Thus, subfecundity due to psychopathology probably assumes far greater importance in transitional societies than in traditional ones. However, little research attention has been directed toward this idea. Kwaku Adadevoh comments on this with respect to Africa:

> "Although several psychological variables are of possible relevance as determinants of sub-fertility and infertility, these have received little study despite the rapid socio-cultural, political, and economic changes being experienced in most African countries. Impotence induced by fear, lack of emotional compatibility between partners, homosexuality, changing sexual partners and patterns due to widespread use of contraceptive devices, fatalism, marital adjustment problems and changing cultural values could play a role in influencing fertility."[31]

Early researchers believed that psychopathology accounted for a substantial portion of the depopulation of many primitive societies undergoing transition, but later researchers tended to reject this possibility. However, there is no strong evidence *against* the proposition that psychopathology could have contributed materially to depopulation in these societies, in part by depressing fecundity. Demographer Frank Lorimer has concluded that acute social disorganization can, under certain circumstances, lead to the spread of subfecundity and to behavioral patterns prejudicial to fertility, such as infrequent coitus and marital disruption, and that these effects can persist even to the point of population extinction.[32] In such populations, psychopathology is undoubtedly a key link between the acute social disorganization and both subfecundity and behavior that depresses fertility.

The prevalence of psychopathology also varies substantially between subgroups within a population. In the U.S., for example, there are urban/rural, social class, occupational, and racial differences in the amount and type of psychopathology experienced, and psychopathology-induced subfecundity could be expected to vary accordingly. It is interesting to note that both the super-fecund Hutterites and the high-fertility Old Order Amish have very low rates of psychopathology.

Since various psychopathological disorders are concentrated in certain population subgroups, these subgroups may experience rates of psychopathology-induced subfecundity vastly different from the population as a whole. For example, drug abuse has important subfecundity effects, but the proportion of the total U.S. population of reproductive age which abuses drugs is too small (0.7 percent) to affect the country's total fecundity more than slightly. However, the effect could be much more important in the slums of large cities where drug abuse is a major problem, especially among disadvantaged minorities. Consider, for example, the potential effects of drug abuse on the fecundity of young men in Newark, New Jersey, as suggested by this description published in 1977:

> "The Newark Addiction Planning and Coordinating Agency estimates that city's hard-core heroin addict population at around 20,000, or about 5% of the city's total population of 380,000. A 5% addiction rate is

serious enough, but only when this figure is put into its proper perspective can we begin to understand its real impact.

"More addicts are males, ranging between the ages of 15 to 35. It is estimated that of Newark's 20,000 hard-core addicts, about 17,000 are young men. According to the 1970 United States Census figures Newark has a total population of 53,000 young males between the ages of 15 and 34. If 17,000 of these 53,000 young men are heroin addicts, it means that one-third of all young men in Newark are heroin addicts."[33]

The authors of this passage consider Newark to be a typical eastern industrial city in terms of urban problems. Thus, although drug addiction may not be prevalent enough to significantly affect the fecundity of the entire U.S. population, it can have a potentially substantial impact on that of sizable urban populations.

The prevalence of psychopathology (and resulting subfecundity) also varies over time. Among U.S. women, for instance, alcoholism, smoking, and illicit drug abuse have all increased considerably over the last several decades. The prevalence of psychosexual disorders such as impotence and frigidity is particularly responsive to social change and, therefore, to variations over time.

In sum, psychopathology is an important cause of population subfecundity, one whose impact varies substantially between populations, between population subgroups, and over time.

Disease

The ability of many diseases to reduce individual fecundity is not disputed. Since high prevalence rates have been recorded for many of these diseases, an impact on the fecundity and fertility of severely affected populations could be anticipated. Indeed, disease is singled out as the main cause of the low fertility and high childlessness in many parts of Africa south of the Sahara and in other populations.

The diseases considered here are infectious diseases, spread by bacteria, viruses, or parasites. Some of the many ways they can affect fecundity are noted with respect to each of the three component parts of fecundity—coital ability, conceptive ability, and the ability to bring a pregnancy to a successful conclusion.

Effect on coital ability

Although many serious diseases, such as tuberculosis and malaria, diminish vigor and reduce libido, few are capable of reducing the actual ability to engage in coitus. However, men with African sleeping sickness (African trypanosomiasis) or leprosy often become impotent. And female coital ability may be reduced by the painful blisters in the genital area which accompany recurrent attacks of genital herpes and make coitus impossible or by scarring of the fallopian tubes after septic (infected), usually back-street, abortions. Painful intercourse is also an almost invariable long-term after-effect of female circumcision (removal of the clitoris and the labia minora), traditionally practiced on girls at puberty and even later and still widespread in Africa in particular.

Infertility

Many diseases dramatically affect conceptive ability by interfering with the production of viable sperm (spermatogenesis) by the male or eggs (ova) by the female, or with their proper transport. Any infection with is accompanied by high fevers may alter spermatogenesis. As noted, in some areas, twice-a-year bouts of malaria can depress spermatogenesis and leave men relatively infertile for two to four months a year. Sperm production can also be reduced or stopped altogether by direct infection of the testes, as happens in certain types of leprosy, and with the parasitic infection of Chagas' disease

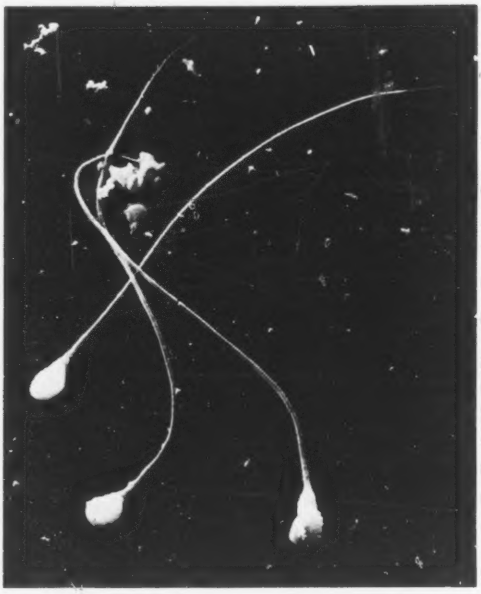


Photo by Dr. David M. Phillips, The Population Council

A scanning electron microphotograph of human sperm. Many infectious diseases can dramatically reduce men's ability to bring about conception by interfering with the production of viable sperm or with their proper transport.

(American trypanosomiasis).

Several diseases can hinder the proper transport of sperm through the epididymis (sperm duct) of the male and of the egg through the fallopian tube of a woman. Gonorrhea is the most widely recognized of these. In its early stages, gonorrhea is more a nuisance than a danger, causing temporary infection in the male's urethra (urine passage) or the female's cervix. But in a certain proportion of cases (1 to 10 percent of females and 1 to 20 percent of males), the infection spreads to the upper genital tract and inflames the fallopian tubes or the epididymis. The resulting scarring can partially or completely block these tubes, depending, in part, on the number of prior tubal infections and how quickly treatment is started. Similarly, when the bacterium of tuberculosis invades the genital tract, nodules are formed along the lining of the epididymis or fallopian tubes. Treatment can eradicate the infection but cannot reverse any tissue damage, and although the tubes may remain open, they are rendered useless. Since gonorrheal and tuberculous infections normally affect both fallopian tubes, sterility is a frequent outcome for women as well as men.

In areas of the world where gonorrhea and genital tuberculosis are both common, it is not easy to determine which (if either) is the cause of any observed sterility since the clinical picture in each disease is very similar. The general tendency has been to overlook genital tuberculosis and ascribe any sterility to the more familiar gonorrhea. As a result, genital tuberculosis is an underrated cause of sterility. It may be particularly important in areas where many women have never conceived (primary sterility) since the disease usually begins before the onset of the childbearing period. By contrast, gonorrhea is contracted during sexual intercourse and women are much more likely to have experienced pregnancy already. In fact, gonorrhea is found even in women with large numbers of children and often in pregnant women. And in some populations with unexpectedly low fertility, there appears to be no correlation between regional rates of gonorrhea and fertility.

Another cause of pelvic inflammation in women is infection after childbirth (postpartum sepsis) or after poorly performed abortion (post-abortal sepsis). The problem bacteria here are found normally in the lower genital tract but tissue damage during childbirth or abortion allows them to enter the upper genital organs. Postpartum and post-abortal sepsis are more likely to be followed by tubal occlusion (blockage) and sterility in developing countries than in developed ones. In developed countries, the infection more often attacks the outside of the tubes, causing a simple thickening of the walls. But in developing countries where women are undernourished and suffer from a number of endemic diseases, any infection is more serious and tubal occlusion is a more frequent outcome.

Female circumcision can also result in sterility by facilitating the spread of infection which leads to the formation of adhesions on the uterus or obstruction of the fallopian tubes.

Two other diseases known to lower conceptive ability are smallpox and filariasis. Disproportionate numbers of infertile men in India have been found to have a history of smallpox; in these men, infertility probably results from obstruction of the epididymis. Filariasis, spread by mosquitoes, is also a cause of tubal obstruction and infertility in men. And although the disease is usually considered a cause of male infertility only, some studies suggest that pelvic infections secondary to filariasis are an important but unrecognized cause of female infertility.

Pregnancy loss

Some of the same diseases which can damage the fallopian tubes and a woman's ability to conceive may also cause pregnancy loss. For example, if the fallopian tube remains open but the lining is distorted or the transport mechanism impaired, the egg may be fertilized, but instead of being carried through the fallopian tube into the uterus, it is trapped in the tube and implants there. Such pregnancies usually end as miscarriages or must be removed surgically. Thus, gonorrheal inflammation, if treated before the fallopian tubes are completely blocked, can lead to a tubal pregnancy. Genital tuberculosis has also been cited as a cause of tubal pregnancy but this is unlikely because even treated victims rarely conceive. Schistosomiasis, a parasitic disease spread by snails which is becoming a serious problem in many parts of the world, is also frequently blamed for tubal pregnancy. However, research shows that this may not be true, for, although the parasite eggs can be deposited in the tubes, they rarely impair the tubes' functioning. One study found no significant difference in the incidence of schistosomal infection of the tubes between women with a tubal pregnancy, women with inflammation of the tubes, and other women.[34] In fact, the exact causes of tubal pregnancy are elusive; in over 50 percent of cases there is no evidence of any tubal inflammatory disease.

Some diseases can bring on pregnancy loss by affecting the unborn fetus. Syphilis is the best known of these. Infection from the mother passes through the placenta to the developing fetus, resulting in miscarriage, stillbirth, or a congenitally syphilitic infant. These disastrous outcomes are effectively limited to the four (and probably the two) years after a woman is first infected with syphilis, before the microorganisms which carry the disease disappear from the woman's blood circulation and burrow into her tissue for a long period of latency. Persons with untreated syphilis cannot be reinfected, so a woman who has had the disease for only a few years or longer has essentially the same chances as anyone else of bearing a live, healthy child. German measles (rubella) caught early in pregnancy can also be transmitted to the fetus with disastrous results, including miscarriage, but the risk is greatest with a woman's first infection although she can be reinfected with the virus several times. Toxoplasmosis, a parasitic disease which can cause brain damage, is also generally thought to result in fetal infection and subsequent pregnancy loss only during a woman's initial infection. But some researchers feel that in some chronic infections the parasites form cysts in the uterus; many fetuses are infected and pregnancy loss occurs repeatedly.[35]

With some diseases, pregnancy loss is the result of a weakened placenta, the spongy mass through which a fetus is nourished. In women with African sleeping sickness, the high rates of pregnancy loss (up to 32 percent) have been attributed to placental infection with the trypanosome parasite. This is probably also an important cause of miscarriage with Chagas' disease. And invasion of the placenta by *P. falciparum*, the parasite in the most serious type of malaria, is a well-documented cause of low-birth-weight infants and probably contributes to higher rates of perinatal mortality.

Pregnancy loss may also occur if a woman becomes anemic with a disease. Anemia is very common with infection by falciparum malaria, and is noted even in "immune" women in areas where malaria is especially endemic. If the maternal anemia is severe, spontaneous abortion and stillbirth may result.

Many diseases are associated with high fevers and this can be yet another cause of pregnancy loss. In a non-immune woman, malaria infection results in high levels of parasites in the blood (parasitemia) and, correlated with this, high fevers, high enough to cause miscarriage and stillbirth. Women who live where malaria is hyperendemic are likely to acquire enough immunity to limit the level of parasitemia and fevers are not sufficiently intense to cause pregnancy loss. But in areas where malaria is a common but not a constant feature of life, immunity levels can fail and an infection can result in high fever and pregnancy loss.

Obstetrical complications occur in nearly every woman who has been circumcised and this, too, can cause pregnancy loss. Scarred tissue can leave the vagina so inelastic that passage of the baby is impossible or leaves it so exhausted that vulnerability to infection is increased.

Thus, fecundity is seriously threatened by many diseases (and in Africa by widespread female circumcision). The extent of such diseases varies greatly between populations so that the amount of subfecundity attributable to them is also a population variable. What was their prevalence in historical societies and today in developing and developed societies?

Historical societies

Certainly many of the diseases which cause subfecundity existed in the past. Gonorrhea, which has been known since classical times, is said to have depressed the fertility of historical European populations. And postpartum sepsis has been implicated in the fertility of historical societies. Infection after abortion was also important. For example, induced abortion was legalized in Russia in 1921 following the Bolshevik Revolution, in order to "combat" the "evil" of growing "underground abortion . . . [in which] 50 percent of women are infected . . . and up to 4 percent of them die." (With hard times and scant contraceptive use, abortion totals mounted rapidly and ostensible fear of the effect on Soviet population growth led to the law's restriction in 1936.)[36] As noted, smallpox and genital tuberculosis may also have significantly influenced fertility in numerous historical societies.

Developing societies

Although the developing world is usually characterized as possessing high fertility, there are large areas where fertility levels are low and childlessness reaches up to 50 percent. Since many of the diseases which cause subfecundity are prevalent in these areas, it is likely that disease is a primary reason for the low birth rates.

Although diseases such as African sleeping sickness probably affect fewer than 100,000 persons a year, others, such as filariasis, schistosomiasis, and tuberculosis each count hundreds of millions of victims. Even the little known Chagas' disease affects 35 million persons in South America. And one "conservative estimate" suggests that female circumcision currently affects 20 million women in Sub-Saharan Africa alone.[37]

In many cases, development has

World Bank photo by James Pickerell

This Upper Voltan is more fortunate than many other women of Sub-Saharan Africa whose fecundity has been undermined by rampant infectious disease.

worsened rather than improved the health situation. The Aswan dam in Egypt and other irrigation projects have provided new breeding grounds for the snails which transmit schistosomiasis. Malaria is resurging in many parts of the world because irrigation projects have supplied the Anopheles mosquito with new breeding pools. Meanwhile, spraying programs using DDT, a petrochemical, have become prohibitively expensive with the rise in oil prices, and the parasites are beginning to show resistance to synthetic anti-malarial drugs. As a result, estimates of persons annually infected with malaria now run as high as 600 million.

Gonorrhea has also spread as development increases the contact between cities and villages. In the villages, far from laboratories and good medical care, gonorrhea infections are seldom diagnosed and treated in the early stages and the more serious complications are more common. Another venereal disease, syphilis, though often mentioned as of some significance in developing areas, is probably not terribly important in the tropics. The disease was said to be a major cause of infant death during the 1930s, but it is now believed that kwashiorkor (caused by protein deficiency) and sickle cell disease had been misdiagnosed as congenital syphilis. The high frequency of positive blood tests for syphilis in some areas of Africa may be misleading as other tropical diseases, such as yaws, also give positive reactions.

Infection after childbirth has long been a problem in developing areas. Many women have contracted pelvises, due to malnutrition and perhaps rickets in childhood, which can make labor long and difficult and thus increase the risk of tissue damage and subsequent pelvic infection. The cities of the developing world are now also witnessing tremendous increases in pelvic infection due to self-inflicted or back-street abortion. One study in Kinshasa, Zaire, attributed 95 percent of all obstetric fatalities to hemorrhage or septic complications following induced abortion, which is still illegal in most of Africa.[38] The same study estimated that 20 percent of all women aged ten or over had active or healed pelvic inflammatory disease. These data suggest that, at least in the cities, blockage of the fallopian tubes—the commonest cause of female infertility in developing nations—is due in large measure to septic abortions. In this series, tuberculosis was also seen in one-fifth of cases. In a population with so much tuberculosis, genital tuberculosis could also be a factor in the high prevalence of pelvic inflammatory disease.

Developed societies

Disease is not nearly so important as a cause of subfecundity in developed societies since most serious infectious diseases have been wiped out or brought under control. But some population subgroups, particularly the poor, elude even the extensive health care networks. In the U.S., for example, pockets of tuberculosis are seen in the Southwest among Mexican immigrants. And disadvantaged minorities have higher rates of venereal disease. But with the relaxation in sexual mores and abandonment of the condom (which prevents transmission of venereal disease) in favor of other contraceptive methods, venereal disease is on the increase in all segments of society. In the U.S. alone, three million cases of gonorrhea are reported every year, and a frightening number of young women, up to 100,000 by one estimate, are becoming sterile each year as a result. Non-gonococcal urethritis and cervicitis (NGU/C—inflammation of the urinary passage in males and of the cervix in females) are increasing far faster than gonorrhea, affecting four to nine million Americans each year. While gonorrhea is still predominantly a disease of the poor, NGU/C is seen mostly in sexually active singles from the middle and upper classes. Unfamiliar with NGU/C, many physicians misdiagnose and treat this disease as if it were gonorrhea. This can have serious repercussions, since the organisms which are usually responsible for the infection are insensitive to penicillin, and, if they should ascend to the fallopian tubes, the chances of tubal blockage are three times what they are with gonorrhea.

Genital herpes is also an increasing public health problem. Anywhere from a quarter to one million Americans are infected each year. Since genital herpes is incurable, the effects on fecundity are potentially great. As noted, recurrent attacks of the disease, which occur three or four times a year, may be accompanied by painful blisters which make coitus impossible. And the spontaneous abortion rate among pregnant women with genital herpes is three times that of the general population. The spread of genital herpes has been enhanced not only by a greater frequency of casual sexual encounters but also by the use of oral contraceptives since these increase vaginal secretions which allow the virus to be transmitted more rapidly.

Nutritional Deficiencies

Famine

Famine is the most striking illustration of the power of nutrition to depress fecundity. The first observation of this phenomenon has been attributed to the French historian Jean Meuvret who observed in 1946 that conception rates fell during the famines under Louis XIV. When demographer Louis Henry subsequently established that birth control was rare among the French poorer classes in the 17th and 18th centuries, this fertility drop during periods of famine was seen as due less to contraception and abstinence and more to involuntary biological factors.

Starvation-induced subfecundity has since been noted in several other historical populations. Significant numbers of poor women in Germany during World War I and in France in World War II became subfecund because of food shortages. But the famine in The Netherlands during the winter of 1944-45, the "Dutch Hunger Winter," is probably the best studied. During this last year of World War II most women in Dutch cities were suffering from hunger, not just the poor. Fifty percent became amenorrheic, indicating that ovulation had stopped, and only 30 percent continued to menstruate normally. Conception fell to one-third the normal rate, probably due to lower coital frequency and delayed marriages as well as infertility. No significant increase in pregnancy loss was noted, however, although children who were gestating at this time had below-normal birth weights.[39]

The importance of psychic stress in such amenorrhea must not be overlooked. For instance, at the end of World War II, 15 percent of the female patients in the hospitals of Dallas, Texas, were amenorrheic, up from one percent at the beginning of the war.[40] Certainly these women were not undernourished, and their amenorrhea was probably due to accumulated anxiety and tension over the outcome of the war and the fate of their loved ones. And the amenorrhea seen so often in the starvation-ridden German concentration camps may also have been caused more by psychic stress and less by undernutrition than might be supposed. Although 54 percent of the 10,000 women who entered Theresienstadt became amenorrheic, they did so within the first three months of imprisonment, before their body stores of nutrients could have been severely depleted. But 18 to 20 months later, after their nutritional status had deteriorated considerably, a great majority of these women began to menstruate normally.

Three hypotheses fit this situation. One is that an acute change in the quality and quantity of food caused the amenorrhea and that gradual accommodation to this nutritional stress resulted in the resumption of menstruation 18 months later. A second hypothesis is that psychic stress, not nutritional stress, was the primary cause of the amenorrhea, and that gradual acceptance of and even resignation to their fate reduced such stress and menstruation returned. But, in fact, the most reasonable hypothesis, and the one specialists subscribe to, is that "war amenorrhea" is the result of multiple stress, both psychological and dietary.

The effects of starvation on the male have not been as extensively studied since they are not quite so evident. It has been noted, however, that starving males experience, successively, loss of libido, decreased sperm counts, loss of sperm motility, and, eventually, the cessation of sperm production.[41]

Chronic malnutrition

As dramatic as these examples are, famine and starvation play only a minor role in human nutritional deficiencies. Far more lives are lost, or at least shortened, by chronic malnutrition, and the effect on population subfecundity is potentially more important. Since malnutrition refers to improper diet of any sort, it describes the overnutrition common in the developed world as well as the inadequate nutrition of the developing world. In the former, overeating and/or the eating of too many salty, fatty, sugar-laden foods contribute to obesity and related diseases such as diabetes and hypertension.

Obesity is very common in the developed world. In the U.S., 10 to 12 percent of children and 35 to 50 percent of middle-aged adults are overweight. Obesity is increasingly being recognized as a cause of subfecundity in men and women. In men, obesity has been implicated as a cause of secondary impotence and of reduced sperm counts. Obese women may be relatively infertile because of a greater frequency of irregular menstruation and amenorrhea. And pregnancy in an obese woman is risky for the fetus, as prolonged labor and pre-eclampsia (a form of high blood pressure) are more common. The association of obesity with pre-eclampsia is somewhat puzzling, however, as this pregnancy complication has also been noted in the hungry world.

Obesity is also an important precipitating factor in two chronic diseases, diabetes and hypertension. Both of these conditions are largely hereditary, but are often unmasked by certain environmental factors such as diet. Diabetes has already been discussed under genetics as a cause of coital inability, infertility, and pregnancy loss. Hypertension, like diabetes, is more likely to surface in obese persons. Weight loss and a low salt diet often help to lower blood pressure, but proper control usually also requires daily medication, and this medication may initially cause impotence and ejaculatory disorders in some men. Hypertension in pregnant women is a serious matter and carries significant risk for the offspring as well as the mother. As important as these effects are, the impact of diabetes and hypertension on population fecundity is not as great as might be expected since these diseases usually develop toward the end of the reproductive period or later.

Although overnutrition is the primary type of malnutrition in developed nations, undernutrition in significant population subgroups must not be overlooked. In the U.S., for example, chronic undernutrition is seen in poor, minority ethnic groups, Indians living on reservations, migrant workers, and among the aged.[42]

Chronic undernutrition is, of course, most widely observed in developing societies. The nutritional situation varies considerably from region to region. In some areas, there are outright shortages of foods necessary to an adequate diet. In others, diets are adequate but deficiencies develop because parasites such as hookworm compete for essential nutrients, gastro-intestinal infections prevent assimilation of ingested foodstuffs, and repeated, closely-spaced pregnancies and breastfeeding place a continuous nutritional burden on women which does not allow for a period of replenishment.

Malnutrition—whether due to a deficiency of a particular nutrient or of a more general nature—has many effects on fecundity. Specific deficiency diseases such as anemia and pellagra can limit reproductive potential. Iron-defi-

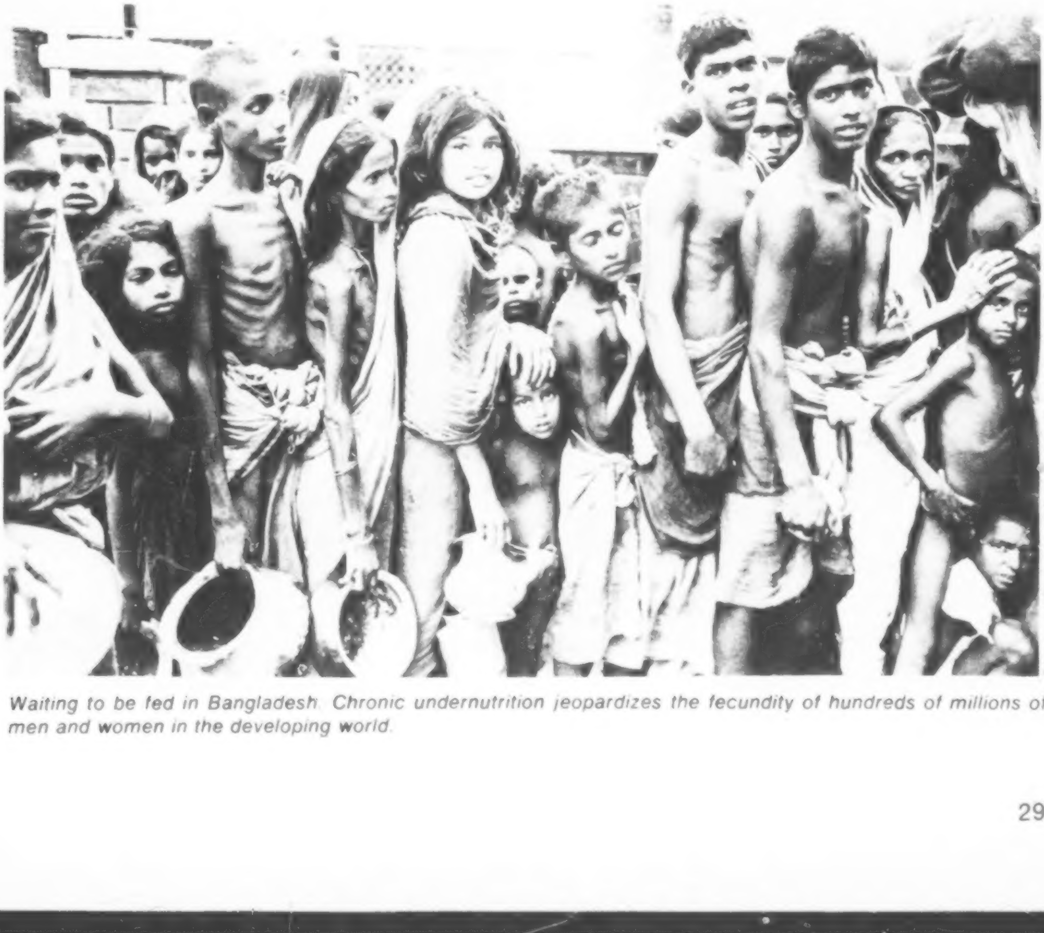


Photo: U.S. Agency for International Development

Waiting to be fed in Bangladesh. Chronic undernutrition jeopardizes the fecundity of hundreds of millions of men and women in the developing world.

ciency anemia, caused either by inadequate intake of iron or by abnormal loss of iron to parasites such as hookworm, is associated with elevated rates of perinatal mortality. In some areas of the world, 5 to 15 percent of adult women are anemic, pregnant women being disproportionately represented because of the demands of the developing fetus for iron. Perinatal mortality is two or three times more frequent in cases of severe maternal anemia. In less severe cases, low birth weight and prematurity are thought to be common pregnancy outcomes, but the many other poor health factors in anemic women make it difficult to be sure that the anemia alone is the cause.

Pellagra, caused by a deficiency of protein and vitamin B, is also seen as a cause of subfecundity. It is endemic in Italy, Romania, and Spain and was quite common in the southern U.S. in the early part of the 20th century. The disease has several fecundity-depressing aspects: skin lesions on the genitals make pellagra victims more susceptible to venereal disease; female victims suffer irregular menstruation and amenorrhea; and pregnancies are complicated and may result in fetal death.

Deficiencies of other vitamins have been suggested as factors in subfecundity with both men and women. Lack of vitamin A, E, or C is believed to suppress sperm production, and spontaneous abortion caused by abnormal uterine bleeding has been attributed to deficiencies of vitamins C, K, and P. However, most of the data to support these hypotheses come from animal studies and any real influence on human reproductive potential is debatable.

Specific deficiency diseases usually occur only in selected groups, particularly infants and young children, and pregnant and breastfeeding women. General undernutrition, however, is much more common and any effects on fecundity are potentially very important. Severe undernutrition, which affects tens of millions of persons worldwide, is associated with amenorrhea and progressive sperm failure, just as is the more serious but fortunately now rare starvation from famine. Less serious undernutrition affects hundreds of millions. In the poor countries of the world, one-half to two-thirds of children are undernourished.

Perhaps the most serious consequence of chronic undernutrition for fecundity is contracted pelvis. For women with this skeletal deformity, labor in childbirth is often prolonged and complicated, and the chances of producing a live baby are severely reduced. Instruments must often be used for the delivery and non-sterile conditions can cause pelvic infection and subsequent sterility.

Undernutrition may also cause delayed menarche and an extended period of adolescent sterility. Chronically undernourished women experience more irregular menstrual cycles without ovulation, and also more pregnancy loss, longer amenorrhea linked with breastfeeding, and a more rapid fecundity decline with age. In undernourished males also, sexual maturation is delayed and fecundity declines more rapidly with age. Exactly how these effects occur is still being investigated and opinions vary. Nevertheless, it is usually thought that the reproductive organs remain responsive to hormonal stimulation and that the problem is at the hypothalamic-pituitary level.

Several of these subfecundity effects are well documented. Many studies have shown nutrition to be an important determinant of age at menarche and at menopause. One U.S. study placed the average age at menarche for well-nourished girls at 12.43 years against 14.45 years for poorly nourished girls. Another in New Guinea recorded menopause as occurring almost four years earlier in malnourished women than in their better-fed counterparts. However, the role of chronic undernutrition in other subfecundity effects is controversial.

There is some disagreement, for example, over the importance of undernutrition in pregnancy loss. Many researchers believe that a causal relationship exists. In fact, the large decline in fetal loss in the U.S. after 1940 has been tied to improved nutrition. But physician-demographer Henry Mosley feels there is little evidence for such a link while admitting that the difficulty of studying early pregnancy loss could allow some fetal loss to go undetected.[43] The evidence linking starvation and pregnancy is evenly divided. Pregnancy loss was higher than usual during famines in Biafra and Greece, and twice the normal rate during the Siege of Leningrad in 1942. However, no such effect was reported for the Dutch famine or for the 1974-75 famine in Bangladesh.

Also debated is the effect of a mother's nutritional status on the length of amenorrhea after childbirth—an important determinant of birth intervals and, hence, family size. While many studies show that amenorrhea lasts longer with undernourished women, it may be that nursing patterns—frequency, duration, and intensity of breastfeeding—have more to do with the length of postpartum amenorrhea than how well a woman is fed.

One undisputed, albeit indirect, effect of malnutrition on fecundity is the undernourished's far greater vulnerability to disease, many of them potent causes of subfecundity. Tuberculosis, for example, develops most frequently in the undernourished, and, as noted, genital tuberculosis can lead to irreversible sterility.

Although famine can undoubtedly depress fecundity to such a degree that fertility levels fall, famine is an infrequent occurrence and its demographic importance is minimal. Chronic undernutrition is far more prevalent, but any associated subfecundity is questionable, with the exception of a clear effect on age at menarche and age at menopuase. But since reproductive ability is already low at these extremes of the reproductive period, Mosley argues that it is unlikely that nutrition can alter fecundity to the extent of registering direct effects on fecundity.[44] Indeed, some research at the population level has been unable to show any significant effect on fertility.[45] But other researchers feel that there is every reason to believe that the biological effects of nutrition on fertility are "profound."[46]

Environment

In the demographic literature, the focus in dealing with environmental effects on fecundity has been on natural environmental factors such as heat (climate), light, and altitude, and on the hazards of radiation. Although data show lower conception rates in hot weather, this is probably not the result of diminished fecundity but simply a reflection of lower coital frequency when the thermometer mounts. It has also been shown that temperature is not an important variable in determining age at menarche or menopause. Changes in the length of day and night, although defining the breeding cycle of many animals, have little or no effect on human fecundity. Altitude does, however, affect human reproductivity, the low oxygen tensions at high altitudes resulting in reduced fertility which is readily reversible by migration to lower altitudes.

Radiation

The effects of high-dose radiation on fecundity were demonstrated by the increased incidence of spontaneous abortions and stillbirths among pregnant Japanese women who were near the sites of the atomic bomb explosions at Hiroshima and Nagasaki. Surprisingly, no long-term effects on fecundity have been noted; these women subsequently showed no increased rates of sterility, fetal loss, or defective births. Sperm levels were reduced for men near the center of the blast, but these too returned to normal. This recovery of spermatogenesis has also been observed in nuclear workers accidently exposed to high doses of radiation. Four months after exposure these men were sterile; 21 months later spermatogenesis had returned; and full fertility was present 41 months after initial exposure.

The effects of low-dose radiation, such as medical X-rays, on the developing fetus have been known for some time. But the notion that low doses are harmless to adult tissue is disappearing quickly with reports of cancer among persons X-irradiated for skin and sinus problems and of excess cancer mortality among men overhauling nuclear submarines. Low-dose radiation may also affect fecundity; fertility problems were recorded in the 1950s for shoe salesmen who used a fluoroscope to check the fit of shoes. Because of the increasing use of radioisotopes in medical research and industry, the proliferation of nuclear power plants, the increasing amount of radioactive waste, and the escalating use of medical X-rays, the level of radiation in the environment is growing at an alarming pace, increasing the chances of any negative effects on fecundity. The recent near-explosion of a reactor at the Three Mile Island nuclear plant in Middletown, Pennsylvania, is a sobering example of how the proliferating use of nuclear materials can result in the potential exposure of large numbers of people to low, but not insignificant, amounts of radiation. (The current and planned proliferation of nuclear power reactors in the U.S. is shown in Figure 2 on page 34.)

Toxic chemicals

Radioactive materials are not the only toxic materials accumulating in the environment. Toxic chemicals used in the manufacture of pesticides, herbicides, plastics, and many industrial products are multiplying at a prodigious rate. Seventy thousand chemicals are now widely used and an additional 1,000 are introduced every year. An alarming number of these chemicals are being identified as causing cancer and other serious health problems such as sterility, pregnancy loss, and birth defects. Government regulatory agencies have often been unable to successfully evaluate the safety of a particular chemical, and many health alarms have been sounded by alert citizens.

Men working in the manufacture of the pesticide DBCP asked for fertility tests after noting that no pregnancies were occurring among their wives. Tests showed half the men to be sterile, with zero or low sperm counts. Women in Oregon, noting the high incidence of miscarriage in their community following seasonal spraying with the herbicide 2, 4, 5-T, urged government study of the effects of the chemical. Investigators found that exposed women had spontaneous abortions at three times the normal rate and the Environmental Protection Agency placed an emergency ban on the product and a closely related chemical, Silvex, which is used by homeowners as a weed killer. It is becoming increasingly evident that the health and fecundity of people in industrialized nations are being threatened at the workplace, by the air they breathe, the water they drink, the food they eat, and even by the clothes they wear.

Occupational hazards

A half century ago an English doctor noted that scrotal cancer was much more frequent among chimney sweeps, probably due to prolonged exposure to soot. Since that time many more occupations have been identified as damaging health and fecundity. Anesthesiologists are at a particularly high risk. Women in this profession who work while pregnant have an increased rate of miscarriage, according to studies in the U.S.S.R., Denmark, and the U.S. Other studies have noted higher rates of sterility for all operating-room personnel and an increase in congenital malformations among babies born to women whose husbands are anesthesiologists.

Men and women whose workplace is contaminated by lead dust are also threatened by high rates of sterility and pregnancy loss. But new federal guidelines to lower the allowable level of lead in factories will offer more protection for the almost one million Americans who are at risk of developing lead poisoning on the job.

A newly recognized occupational hazard involves the manufacture of synthetic estrogen in oral contraceptive plants. Breast enlargement with and without a decrease in sexual drive was noted among male employees, while menstrual abnormalities appeared in female employees. In one plant, unsuccessful pregnancy was 2.5 times higher for persons working in research and development than for administrative personnel.

Increased rates of pregnancy loss have been recorded for women whose husbands work with vinyl chloride, a chemical used in the synthesis of polyvinyl chloride, PVC, a widely-used plastic. Rates of miscarriage and stillbirths among these women doubled after their husbands began working with vinyl choloride.

One of the most startling revelations of an occupational hazard that affects fecundity was the 50 percent rate of sterility among men involved in the manufacture of the pesticide DBCP. The workers were well protected against contamination—coveralls, hoods, and respirators were required as well as an atmosphere of only 1 part of DBCP per million. The results suggest that even minute amounts of DBCP can suppress sperm production. Thus, an effect on farmers, who use the pesticide to kill microscopic worms, and, indeed, on consumers of treated produce, is possible.

Millions threatened

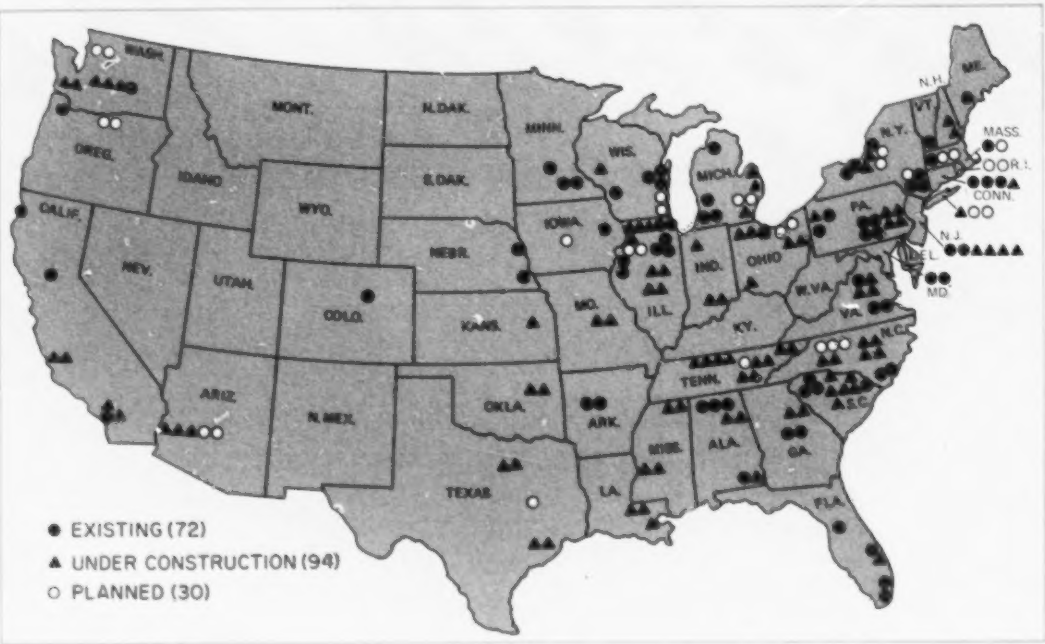
Far more Americans than just chemical workers are threatened by the many poisonous chemicals that have now found their way into the air, water, and soil. Studies of all families living in towns where PVC is made show a rate of birth defects three times more than normal. PCB, a widely-used industrial chemical, is found in dangerous levels in fresh water fish. High levels of PCB and other toxic chemicals implicated in reproductive failure have also been found in numerous samples of human breast milk.

Photo: United Press International

Miscarriages at a rate 50 percent higher than normal have been recorded in the community built on this toxic chemical dump site, near the chemically-contaminated Love Canal at Niagara Falls, New York.

Much of the environment is being contaminated because of inadequate procedures for the disposal of industrial waste, because many products go into widespread use before all health effects are known, and because of accidents. The first of these conditions may be the most hazardous and most difficult to rectify. Containment and burial proce-

Figure 2. Nuclear Power Reactors in the U.S., January 1979


WASH.
OREG.
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WYO.
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N.H.
ME.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
● EXISTING (72)
▲ UNDER CONSTRUCTION (94)
○ PLANNED (30)

Source: U.S. Department of Energy

dures that were deemed safe 20 years ago are now recognized as being grossly inadequate. The U.S. countryside is mottled with chemical dump sites that are virtual time bombs—toxic chemicals stored in rusting barrels that can rupture, poisoning an entire community. Attempts to locate these dump sites before there is a catastrophe will often meet with failure, since chemical companies have often subcontracted their waste disposal to "recycling" firms, many of which are no longer in business, their records lost. Thus the incident at Love Canal in New York state, where an entire community was built on a toxic chemical dump site, is probably just the first in a series of such tragic events. The total health effects of the leaking chemicals on the residents of Love Canal will not be known for many years, but already a miscarriage rate 50 percent higher than normal has been recorded.

That chemicals can be widely used before their health effects are known is illustrated by the case of TRIS. In order to comply with a new federal regulation requiring that children's sleepwear be fire-retardant, manufacturers hastily added TRIS to their pajamas. Just as hastily, TRIS-treated clothing was removed from the shelves when further animal tests conclusively demonstrated that the chemical could cause cancer. In addition, there were fears that boys wearing TRIS-treated pajamas could become sterile and develop sperm mutations and testicular abnormalities. Interestingly, TRIS is a chemical cousin to DBCP which caused sterility in male chemical workers.

A tragedy in Michigan in 1976 is an example of how a simple mistake can have serious repercussions on environmental safety. The first sign that something was wrong came when many livestock in the state became ill and died.

After some sophisticated sleuthing, it was found that bags of PBB, a toxic industrial chemical, had been mistaken for a feed additive. Many farm products were contaminated and an estimated 9 million Michiganders were exposed to PBB in varying levels. Farmers were the most heavily contaminated and some farm women reported menstrual disorders. But contaminated food is not limited to the Michigan experience. Almost 14 percent of the meat and poultry sold in U.S. supermarkets may contain illegal residues of chemicals suspected of causing cancer, birth anomalies, and other toxic effects.

The magnitude of the effects of environmental pollution on fecundity can only be guessed. So many hazards are still unidentified, and the total impact of identified hazards may be far greater than is currently observable. What is certain is that ongoing technological development, the introduction of new products, and increasing urbanization and industrialization will all magnify the problem.

Contraceptives and induced abortion

Technological development and scientific advances have created an additional threat to human fecundity. Advanced methods of limiting fertility, for example, may be lowering fecundity as well. A minority of women develop amenorrhea after discontinuing use of oral contraceptives; in some of these women the amenorrhea may persist for years. But the condition nearly always cures itself or is responsive to drug treatment.[47] Pill use has also been linked to the increase in genital herpes since it makes the genital tract more susceptible to inflection with this virus. And in predisposed women, use of the pill may lead to overt diabetes with all the subsequent risks to fecundity.

The intrauterine contraceptive device (IUD) has been linked to some risk of pelvic infection which may cause sterility and disappointment among a few of its users who later hope to bear children.[48] Low-grade pelvic infections are three to nine times as likely to develop in women using an IUD as in sexually active women using another type of contraceptive method. One particularly hazardous type of IUD, the Dalkon Shield, with a complex tail that facilitated the transmission of bacteria from the vagina into the uterus, was withdrawn from the market after several deaths and more than 200 septic spontaneous abortions had been traced to its use.

The damage that "back-street" induced abortion can inflict on a woman's fertility potential has been recognized as long as this ancient method of birth control has been practiced. Now with the increasing number of abortions in countries where restrictive laws have been eased, it appears that even legal abortions carry some risk. Pelvic infection and endometriosis (a condition in which uterine tissue is found elsewhere in the pelvic cavity, such as in the fallopian tubes) are both possible outcomes of legal abortions and both can cause sterility. Preliminary findings from an as yet uncompleted study which traced more than 40,000 U.S. women who had an abortion or a live birth in 1970-71 suggest some increased risk of pregnancy loss following legally induced abortion.[49]

The method used for the abortion probably makes a difference. This is evident from a World Health Organization study which examined the outcome of pregnancies among 1,600 women in eight European cities who had previously had an abortion either by dilatation and curettage (D & C), the "classical" abortion technique for the first three months of pregnancy, or by the newer vacuum aspiration method which reduces the risk of perforating the wall of the uterus. The results suggest that D & C carries an increased risk of miscarriage with later pregnancies that vacuum aspiration does not, although prior abortions by vacuum aspiration are associated with slightly more premature and low-birth-weight infants than D & C.[50] The safer vacuum aspiration technique is now by far the preferred method in the U.S., accounting for 84 percent of the estimated 1.2 million legal abortions performed in 1976.[51]

Fecundity Variability Between Populations

Subfecundity factors vary in type and prevalence from population to population, and thus fecundity also varies between populations. If population fecundity is thought of as a continuum, the Hutterites would establish the upper extreme and the population of the Bas-Uele district of Zaire would perhaps represent the lower extreme. Among the latter, subfecundity is rampant, as evidenced by the nearly 50 percent childless rate for women aged 30 to 34 during the 1960s.[52] By contrast, only 2 percent of any one cohort of ever-married Hutterite women are childless. The Hutterites are probably genetically super-fecund, virtually all individuals being the offspring of parents with eight or more children. They are prosperous enough to provide each individual with a nutritionally adequate diet and have a social system that ensures that each person receives it. They avail themselves of two of the world's most advanced health care systems (those of the U.S. and Canada), which minimizes disease and its consequences. They have extraordinarily low rates of psychopathology. And, as members of simple farm communities, they avoid most of the environmental factors that depress fecundity.[53] By contrast, poverty deprives inhabitants of Bas-Uele of proper nutrition and health care; malaria and other subfecundity - producing diseases are endemic and epidemic; and the devastating social forces at work in this rapidly changing society probably ensure substantial rates of psychic stress and other forms of psychopathology. Virtually all other populations experience a degree of fecundity somewhere along the continuum bounded by the high-fecundity Hutterites and the low-fecundity inhabitants of Bas-Uele.

Fecundity of U.S. blacks

One population in which subfecundity has historically played a key role in determining fertility is that of blacks in the U.S. Beginning in the latter part of the 19th century, the black fertility rate declined sharply until the mid-1930s, and then did a turnabout and rose until 1960 (see Figure 3 on page 38). The trend in childlessness was the reverse, rising during the first period and falling during the latter. Population students have long suspected that these trends were due almost entirely to changing health conditions. This "health hypothesis" holds that subfecundity-producing health conditions increased among blacks from 1880 to 1936, leading to widespread involuntary childlessness and subfecundity and a consequent fall in fertility. The subsequent rise in black fertility and decline in childlessness is attributed to a decrease in the prevalence of these conditions. In his important monograph, *Growth of the Black Population*, Reynolds Farley was the first to develop this idea systematically.[54]

George Masnick and the present writer have also concluded that subfecundity was a more significant factor in the U.S. black fertility trend than in that of its white counterpart.[55] In our analysis, however, two other factors are also recognized as important determinants: changes in the prevalence and effectiveness of various birth control practices, and changes in mate exposure variables such as the proportion of time spent in stable unions. Nevertheless, despite some disagreement on just how influential subfecundity was, there is a clear consensus that it was one of the important causes of the fall in black fertility from 1865 to the mid-1930s.

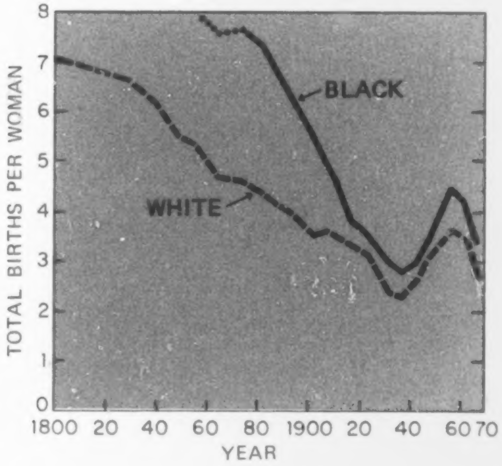
The causes of this subfecundity and their relative importance are still not clear. Early formulations of the health hypothesis focused mainly on the venereal diseases, syphilis and gonorrhea. However, subsequent critiques have shown that their impact on black fertility and childlessness rates was exaggerated.[56] Syphilis has been demoted to a factor of only secondary importance. Gonorrhea retains its status as a primary cause of black subfecundity, but one recognized as having been given undue credit in the past for subfecundity produced by other causes. These underrated causes include genital tuberculosis and postpartum and postabortal infection, general undernutrition and specific deficiency diseases, and psychopathological disorders such as alcoholism and psychic stress.

Take the possible role of genital tuberculosis, for example.[57] TB rates were rising among U.S. blacks as fertility rates were falling. It was only after black TB rates improved substantially that their fertility turned upward. Genital TB is usually a cause of primary sterility, and increasing childlessness was a notable feature of the black fertility decline. Also, childlessness rates were highest and fertility rates lowest in urban centers where TB was most prevalent, and the reverse was true in rural areas. In the South in the early 1900s, childlessness increased and fertility fell in both cities and rural areas. This could have reflected growing interaction between rural and urban areas which helped spread TB more rapidly in rural areas. In addition, economic conditions were deteriorating among blacks in both the city and the countryside, diets were poorer, and the chances for TB to develop thus enhanced. One occupational differential in childlessness, the "mysteriously" high rate among black service workers (domestics and the like), is partly explainable by the fact that many service workers, who have a very high job-related risk of becoming tuberculous, were entering these jobs during their teens when the risk of developing genital TB is greatest. Lastly, secondary sterility (after a woman has had children) can occur with genital TB though not so frequently as primary sterility. This could explain some of the differences in fertility rates observed between tuberculous and nontuberculous black couples in this period. In sum, it appears that genital TB may have been at least as important as venereal disease in causing both the childlessness and reduced family size that led to the

Photo: U.S. National Archives

Deteriorating economic and health conditions among U.S. blacks led to widespread involuntary childlessness and subfecundity and a consequent fall in their fertility from 1880 to 1936.

Figure 3. Total Fertility Rates of U.S. Black and White Women, 1800-1969



Source: Ansley Coale and Norfleet Rives, "A Statistical Reconstruction of the Black Population of the United States," *Population Index*, Vol. 39, No. 1 (1973) cover.

downswing in U.S. black birth rates from 1880 to 1936.

The Future

That subfecundity is a serious problem for many couples is well accepted. And many researchers are now convinced that widespread subfecundity is a chief explanation for the relatively low fertility of some presumably non-contracepting populations, such as those in the swath of countries across Central Africa today. In both developing and developed nations, the primary repercussion of subfecundity, especially childlessness, is disappointment for the couples involved. But in some developing nations, where the repercussions are such that entire areas are threatened with depopulation, subfecundity can be a hindrance to further development.

What, then, can, or is, being done to relieve subfecundity? Certainly identification of the causes is a first step; individuals might then be alerted to avoid or protect themselves from specific diseases, environmental assaults, and other conditions which could limit their reproductive potential. In this vein, many people are now avoiding alcohol and other harmful drugs, taking precautions against contracting and spreading venereal diseases, and choosing to live in areas where life is less stressful and environmental pollutants are at a minimum. Even if a particular subfecundity factor cannot be avoided, many protective measures can be taken. Immunization with rubella vaccine protects against an infection with serious complications during pregnancy. Rh-negative mothers can and should be treated after every Rh-positive pregnancy with biological agents that block the formation of antibodies against Rh. And many persons are turning to transcendental meditation, regular exercise, and other approaches to coping successfully with stress.

But for many individuals, especially in developing countries, there is less chance to avoid subfecundity factors or prevent their effects and subfecundity is already a fact. What can be done to allow these persons to have the children they so desperately want? Medical advances in the treatment of subfecundity have been proceeding at a prodigious rate. Forty years ago only 10 percent of subfecund couples could be helped to achieve a pregnancy. Today 40 to 60 percent of subfecund couples can be helped.

Much coital inability stems from psychosexual disorders such as impotence and dyspareunia (painful coitus in women), and the pioneering work in sex therapy of Masters and Johnson, together with more conventional types of psychiatric treatment, have brought tremendous improvements in this area of reproduction.

Psychosexual disorders can also impair male and female conceptive ability, and these treatments have worked well here also. Hormonal abnormalities also play a role in conceptive defects. Insensitivity of the testes to hormonal stimulation is the reason for at least some previously unexplained cases of low or zero sperm counts, but more research is needed before effective treatment methods can be devised and implemented. But ovulatory failure in women caused by a hormone deficiency is well understood and present treatment methods have been very successful, producing a pregnancy in 35 percent of cases. In the more intractable cases of ovulatory failure, more radical methods of treatment have resulted in multiple pregnancies, some women having produced up to 15 non-viable fetuses at a time. A very recent discovery is that small, benign tumors of the pituitary gland are an important cause of infertility in the some 15 percent of American couples who are involuntarily childless. These tumors secrete a hormone, prolactin, which interferes with the ability of the pituitary to secrete those hormones which stimulate the ovary and the testis. Using new microsurgical techniques, physicians have been able to safely remove these tiny growths, and three of the first ten women to undergo this operation have become pregnant.[58]

Microsurgery also offers new hope to those 8 percent of infertile men and 45 percent of infertile women whose problem is the result of tubal obstruction or other abnormalities. Some of these men and women realize they made an error in judgment and want their vasectomies or tubal ligations reversed. But most suffer from congenital defects or their tubes have been damaged as the result of infections and other pathological processes. In those women whose tubes are missing or so badly damaged that surgical repair is impossible, the only hope for a pregnancy currently rests with the procedure used by Drs. Steptoe and Edwards with Lesley Brown. But the procedure is difficult and the success rate has been low.

Varicocoele, swollen veins in the scrotum, is the prime cause of male infertility, at least in the developed world. This disorder is often cured by relatively simple surgical techniques. Forty-five percent of men operated on for varicocoele go on to become fathers.

The ability of modern medicine to deal with the high-risk pregnancy has increased fetal survival among women with histories of problem pregnancies, hypertension, diabetes, alcohol and drug abuse, and kidney disease. The tremendous improvement in fetal survival among diabetic women whose pregnancies are closely supervised is but one example.

Unfortunately, the promise of some medical and technological advances in alleviating subfecundity has been marred by fears that such advances could be put to insidious uses. The ability of the English team to fertilize a woman's egg outside her body with the sperm of her husband and successfully implant it in her womb has aroused fears of surrogate mothering, cloning, and the like. But such fears are largely unfounded. More concern should perhaps be directed toward making medical advances in every field, including reproduction, more available than they now are to all of the world's peoples. ☐

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German measles (rubella) face increased risks of spontaneous abortion, but the induced abortions obtained by infected women who fear their offspring might be malformed by this virus account for far greater amounts of "pregnancy wastage." Even inadvertent vaccination of pregnant women with the attenuated virus of German measles, though not conclusively known to cause malformations in the fetus, is a frequent cause of induced abortion. In one series, 50 percent of vaccinated women sought abortions, yet not one of the continued pregnancies ended in congenital rubella. Syphilis is also a good example of a subfecundity factor that can indirectly affect fertility through other intermediate variables. Infected persons, as well as those trying to avoid the disease, often use prophylactic procedures during coitus (most commonly, condoms) that are secondarily contraceptive. The discovery of syphilis during the frequently mandatory premarital blood test may force postponement or even cancellation of marriage. And before antibotics, the prospect of giving birth to a child with congenital syphilis was probably a reason for voluntary abortion. Syphilis is also almost certain proof of one partner's infidelity and undoubtedly increases the frequency of separation and divorce.

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Resources, Environment, and Population: The Nature of Future Limits

By Ronald G. Ridker and Elizabeth W. Cecelski

Abstract—This *Bulletin* examines the balance between world supplies of resources and the demands presented by population and economic growth in the recent past, during the period to 2025, and for the long term. Improvement in socioeconomic indicators, relatively stable resource market prices, and evidence of resource and environmental changes suggest that so far the world as a whole has been winning the race between demand and supply. For the next half century, during which a slowdown is projected in growth rates of both population and resource consumption, the most important problems to be faced are associated less with physical exhaustion of resources than with their unequal distribution and the transition problems of moving from one resource regime to another in an orderly fashion. For the long term, a projected equilibrium population of 10 to 12 billion can probably be sustained at a decent standard of living by more equitable distribution of food and shifts from less to more abundant resources: in nonfuel minerals, from such resources as tin, tungsten, and lead to aluminum, cement, and glass; and in energy, from oil and natural gas to coal, various forms of solar energy, and possibly nuclear fusion. Ultimately, environmental and security problems associated with growing energy production and use such as increasing atmospheric levels of carbon dioxide and nuclear proliferation may be the most difficult to resolve. Cessation of population growth would help but by itself does not constitute a solution to the world's resource problems.

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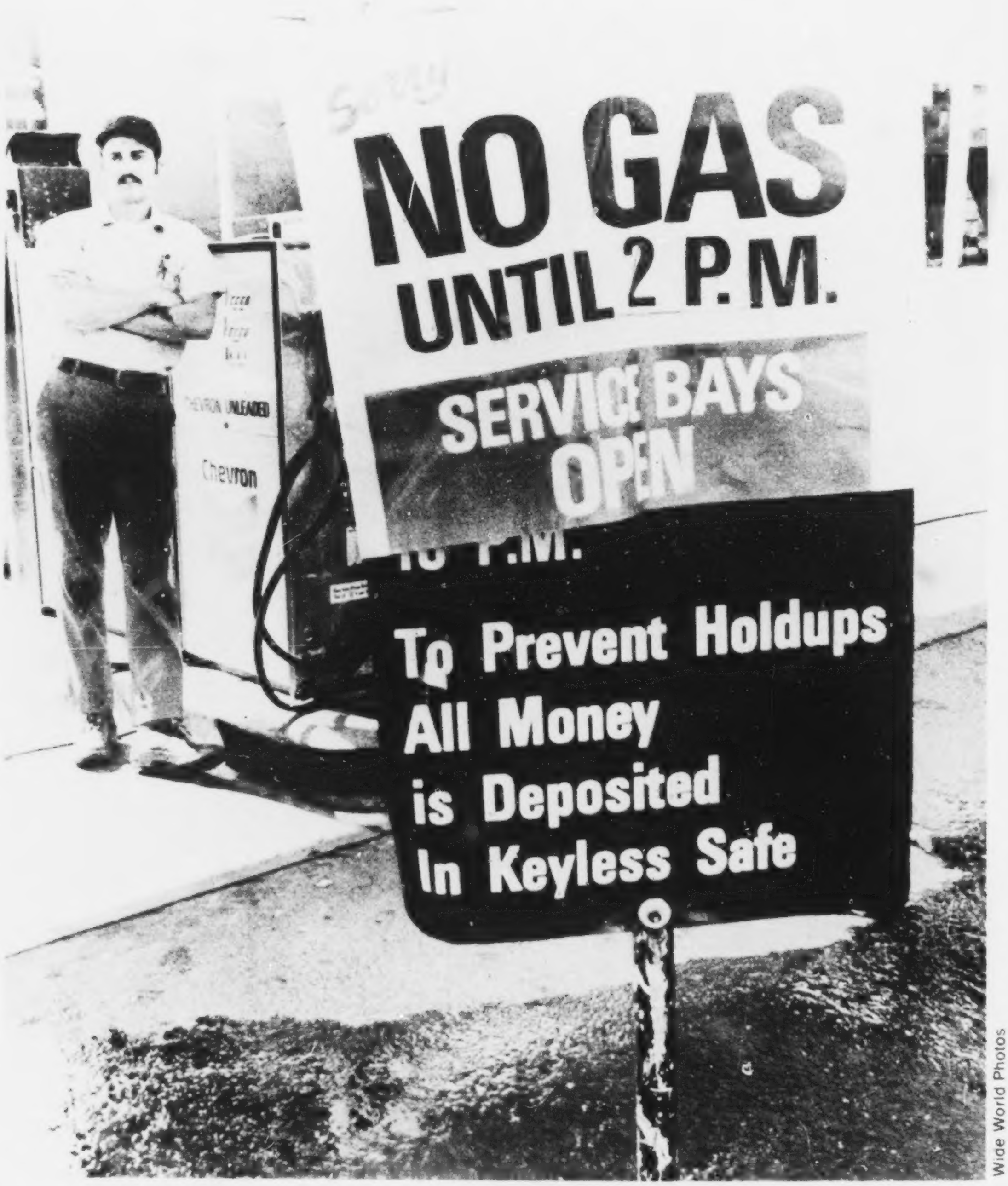
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Gasoline problems in 1979 stemmed more from a production slowdown during Iran's revolution and steep price rises set by the OPEC cartel than from a shortage of world oil resources. However, global resources of petroleum and natural gas are projected to be exhausted in the next 50 to 75 years and the world must prepare to deal with the transition problems of shifting to alternative sources of energy.

Resources, Environment, and Population: The Nature of Future Limits

By **Ronald G. Ridker**
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Speculation about the future of man has been a scholarly pastime for centuries. But in recent years, especially in richer industrialized societies, idle speculation has given way to urgent debate on current policies as the conviction grows that the shape of the future can and must be controlled if problems are to be avoided.

Two views prevail. The first, which can be called the *Limits Thesis*, involves four propositions:

First, it is asserted, there are definite limits to population and economic growth, limits which are imposed by the finiteness of the earth—by the fact that air, water, minerals, space, and all usable energy sources consist of fixed stocks that can be exhausted or flows that can be overloaded.

Second, these limits are very near.

Third, if we permit ourselves to approach these limits too closely, worldwide death rates will soar.

Fourth, even if these limits are further away than we think, population and economic growth *ought* to stop: after a certain point, already exceeded by the rich in both developed and developing countries, the quality of life may actually decline with the introduction of more and more material goods; present wasteful consumption habits are using up resources that ought to be conserved for future generations; and, if the rich would consume less, more would be left for the poor of the world.

As evidence that these limits are near, advocates of this view point to current energy and food problems, to areas of the earth now beset by deforestation, erosion, and desertification, and to the fact that current reserves of many minerals will not last for long if the growth in their consumption continues at present rates.

The opposing view is sometimes called the *Cornucopian Thesis*. It asserts:

First, there are limits to growth only if science and technology cease to advance, but there is no reason why such advances should cease. So long as technological development continues, the earth is not really finite, for tecnnology *creates* resources.

Second, even if scientific advances were to cease, the limits would still be far away: the earth is yet huge relative to the demands being made upon it by man, and the possibilities for substituting more abundant for scarcer resources are so great that there is no reason why population and economic growth cannot continue for a very long time.

In any event, according to this view, growth is good: no society has reached the point where all its material needs are satisfied; growth is the only practical way to create a surplus that can be redistributed to the poor; and growth poses challenges for humanity, giving life a sense of purpose and encouraging greater achievements.

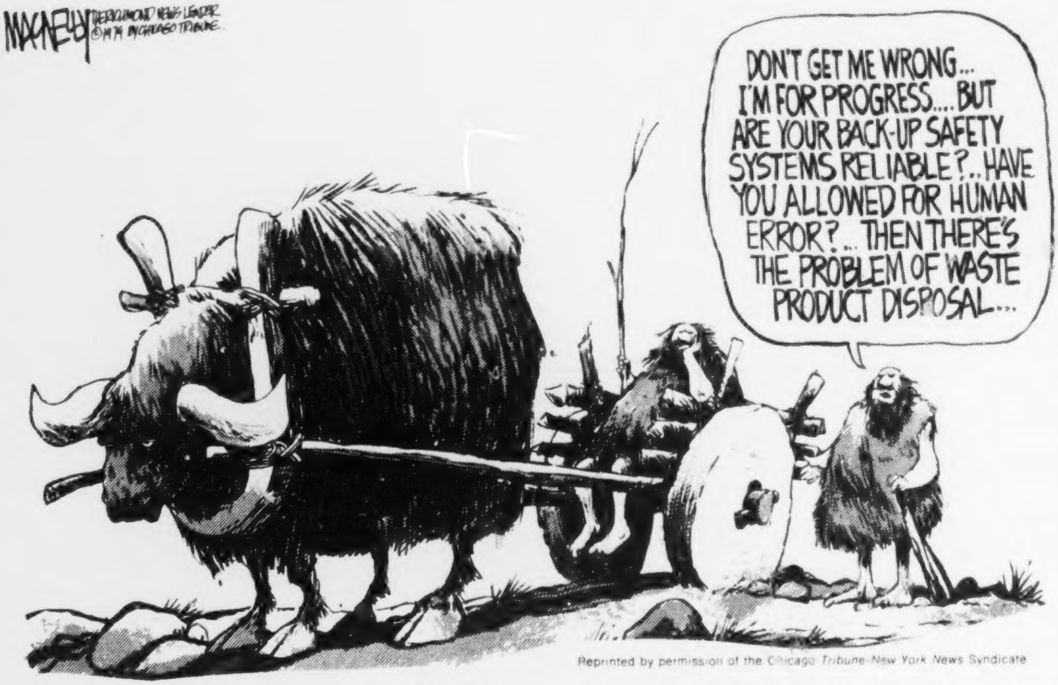
The "Cornucopians" believe that past history provides their best evidence. If one sees behind him a relatively steady stream of progress in material welfare and no signs that technological developments are slowing down, he may reasonably ask why all the concern about the future.

Clearly, the Limits Thesis is on the ascendancy today. But it is worth remembering that neither of these views is new. The Cornucopian view is rooted in the biblical injunction to be fruitful and multiply. The Limits Thesis goes back at least to Malthus who argued in the late 18th century that population, if unchecked, would grow geometrically (2, 4, 8, 16, etc.) while food production could only grow arithmetically (2, 3, 4, 5, etc.). Thus, the standard of living would always tend toward the minimum subsistence level. Malthus wrote his *Essay on Population* in response to his father's optimistic views on the possibility of material progress and a future egalitarian society.[1]

Such cycles of pessimism and optimism have occurred throughout history, and this is unlikely to change. For the future is essentially unknowable. So long as this is the case, views of the future will be dominated by today's problems, perceptions, and moods, which are not necessarily long lasting. Considering the spate of immediate problems this globe now faces, it is little wonder that the pessimists are currently on the ascendancy.

The critical question today is whether this pessimism is more than just another cycle. To what extent is this most recent change of heart about the future of humanity associated with new information about resource and environmental constraints? Has something in the physical or economic world changed to make serious shortages of material or environmental resources more imminent today than they seemed to be just 10 or 20 years ago? Most importantly for this *Bulletin*, what role does population growth play in these potential constraints?

Our own view is that the debate between these two schools is falsely polarized and has become unproductive. The relevant question is not whether to grow or not to grow, but how to redirect present and future economic output in ways that will better serve humanity. Clearly there are physical constraints to population and economic growth, but most of them are distant enough to be managed by adequate planning, good will, and international cooperation—provided we do not procrastinate. For the present our most serious problems are the political, social, and institutional barriers to getting on with the job. A slowdown in the rate of growth—particularly population growth—is important because it reduces the number and intensity of problems that must be resolved simultaneously; but by itself it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DON'T GET ME WRONG... I'M FOR PROGRESS.... BUT ARE YOUR BACK-UP SAFETY SYSTEMS RELIABLE?.. HAVE YOU ALLOWED FOR HUMAN ERROR?... THEN THERE'S THE PROBLEM OF WASTE PRODUCT DISPOSAL...
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Cycles of pessimism and optimism about material progress and the future of humanity have occurred throughout history. The critical question is whether today's predominating pessimism is justified.

cannot resolve these near-term, non-material constraints.

Issues tend to become confused because these non-material constraints frequently create the same results as actual physical scarcities, at least in limited regions. But we must carefully distinguish between artificially created situations, such as the drop in world oil production during the 1979 revolution in Iran, and truly global, physical limits to population and economic growth, for the two are likely to involve quite different policy approaches and implications.

The issues

We have organized this *Bulletin* around a series of questions inspired by a French schoolchild's riddle: If lilies in a pond double each day and on the 30th day have covered the pond, on what day is the pond half covered? The answer is: on the 29th day.[2] This riddle has been used to suggest that the limits to growth may be surprisingly near. But as an analogy to the world situation, the answer is not obvious. It depends on whether the pond (the world resource base) is expanding in size, and, if so, at what speed; whether there are limits to the expansion of the pond; how near we are to those limits; and whether the lilies (the world's population) and their demand on nutrients in the pond (per capita consumption) continue growing at constant rates until they hit the edge of the pool. In other words, the answer depends on the relative rates of growth in demand for and supply of material and environmental resources, and on whether knowledge about what is happening to supply affects the rate of growth in demand and vice versa. Hence our questions:

1. Are there signs to indicate whether in the past we have been winning or losing the race between growth in demand for material and environmental

resources and growth in supplies of these resources?

2. What is likely to happen to demand in the future? Will its rate of growth speed up, slow down, or remain the same?

3. How far and how rapidly can supply—the size of the pond—expand? Is there an ultimate limit; when is it likely to be reached?

Many of the projections on prospects for the future presented in this *Bulletin* are drawn from a recently completed study entitled *To Choose a Future: Resource and Environmental Problems of the U.S., A Long-Term Global Outlook* (Johns Hopkins Press for Resources for the Future, forthcoming 1980), prepared by Ronald G. Ridker and William D. Watson, Jr. for the Center for Population Research, U.S. National Institutes of Health. The time frame chosen was the period from 1975 to 2025, long enough to capture some of the ultimate consequences of population growth but short enough to allow a degree of confidence in our ability to say something useful about the future.

This study projects that, barring serious disruptions in current trends, the world's population will reach nearly 9.4 billion in 2025 compared to 4.3 billion in 1979, despite declining population growth rates, and that the world's per capita Gross National Product (GNP) might then be as high as $2,600 (in 1971 dollars) compared to $1,000 in 1972. Given these projections, the rate of increase in consumption of nonfuel minerals and energy will decline during the period to 2025, although absolute consumption levels will be vastly greater at the end of the period. When these projections are compared with projections of potential supplies, and when the nature of the difficulties in realizing these supplies is considered, it becomes clear that the problems we face in the next half century are associated less with physical exhaustion than they are with unequal distribution of resources, the security of supply lines and trade, environmental problems associated with high levels of use, and above all, with the transition problems in moving from one resource regime to another in an orderly way.

In the world as a whole there appears to be enough land and water to meet food demands during the next half century. But this land and water—plus the know-how, capital and institutions required for their efficient use—are not distributed in the same way as population. International movements of food will have to grow if per capita consumption is not to fall in regions such as South Asia where food production is already barely keeping pace with population growth.

The situation with respect to nonfuel minerals is similar. We must find substitutes for less abundant resources such as tin, tungsten, and lead, and more ways to use abundant resources like aluminum, cement, and glass. And mechanisms must be found to help countries—especially the poorer nations—cope with the disruptive shifts in the terms of trade that such changes in resource use generally entail.

The world's energy problems are the most serious, difficult, and dangerous of all the resource problems the world faces. We already face balance of payment and security problems so far as petroleum and nuclear power are concerned. During the next 50 years these problems will be compounded by the fact that reasonably priced sources of both petroleum and natural gas will be exhausted. This does not mean that the world must learn to live without liquid and gaseous fuels, but it does mean that ways must be found to acquire these fuels from other sources. Adequate alternatives do exist. Liquids and gases can be produced from coal, shale, tar sands, and vegetation, to mention only the most likely sources to be used. And nuclear power and solar energy (captured by using flat plate collectors, photoelectric cells, biomass, and wind, for example) can be substituted for liquids and gases in many uses. The problem is to bring these alternatives into use in an orderly, equitable, and safe way—safe both environmentally and militarily.

In all this, a decline in future population growth would be of considerable help, for it would provide the world with more time and resources with which to solve these problems. But whatever future population growth rates may be, the world will still be faced with unsolved problems resulting from past growth. There are no simple explanations or unidimensional solutions for our problems.

We turn now to our first question: What is the record to date in balancing population and economic growth against available supplies?

The Past: Winning or Losing?

For practical reasons, all projections take off from past trends. Therefore, it is useful to start with what has happened so far, even though the future will not replicate the past. Have population and economic growth rates—the two fundamental determinants of demand for material and environmental resources—been outstripping supply? To answer this question, we can look at several kinds of evidence: (1) socioeconomic indicators of levels of material well-being, to tell us whether life has been getting better or worse for most people; (2) changes in relative price levels, which reflect changes in resource scarcity; and (3) indications of improvement or deterioration in the quantity or quality of material or environmental resources.

Socioeconomic indicators show improvement

If we judge by the goals of economic growth, surely the world as a whole has been winning the race, at least to the mid-1970s. By practically whatever measure of basic necessities or material well-being one judges—per capita incomes, calories consumed, shelter and clothing, hours of leisure, protection against physical dangers and major famines, medical care, infant mortality, or life expectancy—the average person in the world today is at least somewhat better off than his parents and substantially better off than his grandparents. Table 1 (page 8) provides data compiled by the World Bank on a few such indicators available on a comparable basis for most countries. As can be seen, even in the poorest of countries there was some progress in practically every indicator between about 1960 and the mid-1970s. In Pakistan, for example, per capita Gross National Product (GNP) increased annually by 3.1 percent compared to 2.3 percent in the U.S.; energy production per capita increased by 6.0 percent per year, compared to 1.9 percent in the U.S.; and life expectancy at birth rose from 42 to 51 years, compared to a rise from 70 to 71 years in the U.S.

But there are problems with this relatively positive assessment. Most important, these improvements are *averages;* they say nothing about what is happening to the *distribution* of material well-being. While there is no evidence that the poor have become absolutely worse off as the averages have increased,[3] there is evidence that they are not advancing as fast as the figures suggest, that their numbers are increasing, and that the gap between the rich and the poor has grown. This may be related to the process of economic growth itself. Income distribution appears to be worst in countries that have progressed to middling levels of per capita income and best in rich countries. For example, in 1956 in India (a low income country), the lowest 20 percent of the population earned 8 percent of total income while the highest 4 percent earned 20 percent. By contrast, in

Table 1. Selected Socioeconomic Indicators: 1960 to 1976

Country	Population (millions) mid-1976	Avg. annual growth (%) GNP per capita 1960-76	Avg. annual growth (%) Energy production per capita 1960-75	Per capita food production 1965/7 = 100 Avg. 1974/76	Life expectancy at birth (years) 1960	Life expectancy at birth (years) 1975	Infant mortality rate 1960	Infant mortality rate 1975	Population per physician 1960	Population per physician 1974	Percent of age group enrolled in school, Primary 1960	Primary 1975	Secondary 1960	Secondary 1975	Adult literacy rate (percent) 1960	Adult literacy rate (percent) 1974
Low income countries	1,215.5	0.9	7.0	96.0	36	44	142	122	37,000	21,185	30	52	2	8	10	23
Bangladesh	80.4	-0.4	—	95.0	39	42	—	140	—	9,350	47	73	8	25	—	23
India	620.4	1.3	1.9	107.0	42	50	139	122	5,800	4,160	41	65	23	29	24	36
Pakistan	71.3	3.1	6.0	114.0	42	51	142	113	11,000	3,970	30	51	11	15	16	21
Indonesia	135.2	3.4	6.2	117.0	40	48	82	—	41,000	18,160	67	81	6	18	47	62
Middle income countries	894.8	2.8	5.8	104.0	49	58	72	46	3,050	2,430	79	97	12	35	61	63
Nigeria	77.1	3.5	27.0	89.0	34	41	207	163	32,000	25,440	36	49	3	10	25	—
Brazil	110.0	4.8	4.2	114.0	56	61	70	—	3,600	1,660	95	90	11	18	61	64
Industrialized countries	683.8	3.4	2.1	110.0	70	72	25	15	860	650	108	104	53	83	—	99
Japan	112.8	7.9	-5.1	107.0	67	73	31	10	920	870	103	100	74	95	98	99
United States	215.1	2.3	1.9	114.0	70	71	26	16	780	610	118	104	64	91	98	99
Capital surplus oil exporters	12.2	7.0	8.7	—	45	53	—	—	5,800	1,140	59	90	9	45	—	—
Centrally planned economies	1,207.7	3.5	3.6	114.0	66	70	—	—	830	480	100	99	47	62	—	—
China, People's Rep.	835.8	5.2	3.0	108.0	51	62	—	—	—	—	—	—	—	—	—	—
U.S.S.R.	256.7	3.8	4.7	113.0	68	70	—	—	520	340	100	99	73	71	98	99

Source: The World Bank, *World Development Indicators*, June 1978

1960 in Brazil (a middle income country), the lowest 20 percent earned only 3.5 percent of national income, while the upper 4 percent earned 38.4 percent. But in 1969 in the U.S., the lowest 20 percent earned 5.6 percent of total income and the highest 4 percent earned 14.8 percent.[4] In the study on which this finding is based, Taiwan and South Korea were found to be the only major developing countries to have experienced a steady improvement in income distribution along with rapid economic growth. The centrally planned economies of Yugoslavia, Cuba, and the People's Republic of China are the only other exceptions.

The same is true between countries. While developing countries are in general materially better off today than they were two decades ago, the gap between rich and poor countries has undoubtedly widened. For example, in 1960 per capita income in Pakistan was $104 while that of the U.S. was $5,484. In 1976, even though Pakistan's per capita income had grown more rapidly than that of the U.S. in the interim (3.1 versus 2.3 percent per year), the levels were $170 and $7,890, a gap between the two countries some $2,000 greater than in 1960.[5]

This growing gap between developed and developing countries is due in large part to the much more rapid population growth in developing countries, which has greatly reduced the benefits of economic development. Table 2 illustrates this with regard to food production. From 1961 through 1975, the annual rate of increase in food production in developing countries was greater than that in developed countries, but because of more rapid population growth, per capita production grew much more slowly. Per capita food production in

Table 2. Annual Rate of Increase in Food Production in Relation to Population: Developed and Developing Regions, 1961 to 1975

Region	Food production 1961-1970	Food production 1971-1975	Population 1961-1970	Population 1971-1975	Increase in food production per capita 1961-1970	Increase in food production per capita 1971-1975
	(Percent per year)					
Developed regions						
North America	2.4	1.9	1.3	0.9	1.1	1.1
Western Europe	2.3	1.9	0.8	0.6	1.5	1.3
Oceania	3.4	1.3	1.9	1.7	1.5	0.7
Eastern Europe and U.S.S.R.	3.2	2.1	1.0	0.9	2.2	1.1
Total	2.7	2.0	1.1	0.9	1.6	1.2
Developing regions						
Africa	2.9	0.5	2.5	2.7	0.4	-2.1
Latin America	3.0	2.7	2.8	2.7	0.3	-0.1
Far East	2.7	2.8	2.5	2.5	0.2	0.3
Near East	3.3	3.7	2.7	2.8	0.7	0.9
Asian centrally planned economies	2.8	2.4	1.7	1.7	1.1	0.7
Total	2.9	2.5	2.3	2.3	0.6	0.2

Source: Food and Agricultural Organization (FAO), *Billions More to Feed* (Rome: FAO, 1976), p. 8.

1971-75 actually declined in Africa and Latin America, the regions with the highest annual population growth rates in this period (2.7 percent). Another illustration is provided by the case of the Aswan Dam in Egypt. When completed in 1970, the dam increased the country's arable land by a third (800,000 hectares). But because of population growth during the decade it took to build the dam, from 26 to 33 million, food output per capita has hardly improved at all. The gains made in literacy provide a final example. More people are literate than ever before in human history and, worldwide, the proportion of illiterate adults dropped from 44 to 32 percent between 1950 and 1975. Nonetheless, the absolute numbers of illiterate adults have also increased during this quarter century from 700 to 800 million.[6]

Another difficulty with the picture presented in Table 1 is that the world may be achieving these gains in average well-being at the expense of future generations. This would be the case if this generation is using up the world's resource base or environmental carrying capacity faster than new discoveries and technology can expand them. Thus, while it is useful to know that life has been improving for the majority of humanity, this fact tells us nothing about the future. For that we must turn to other indicators.

Past trends in market prices

A better, though far from perfect, way to judge whether resources have become more scarce—that is, whether demands for resources have grown faster than new discoveries and technological changes can provide them—is to observe what has happened to resource prices. If resources have become more scarce, their prices, relative to those of other goods, should have risen.

The most comprehensive and well-known study of historical trends in natural resource prices, *Scarcity and Growth*, by Harold Barnett and Chandler Morse, showed for the U.S. that average prices of most raw materials fell or remained stable in real terms between 1870 and 1957, despite the fact that ores with steadily lower concentrations of minerals were being mined.[7] This was the result primarily of technological advances in mining and processing and sharp declines in the costs per unit of output of labor, capital, and energy. Earl Cook describes the story with respect to copper and the per unit cost of energy used to mine it:

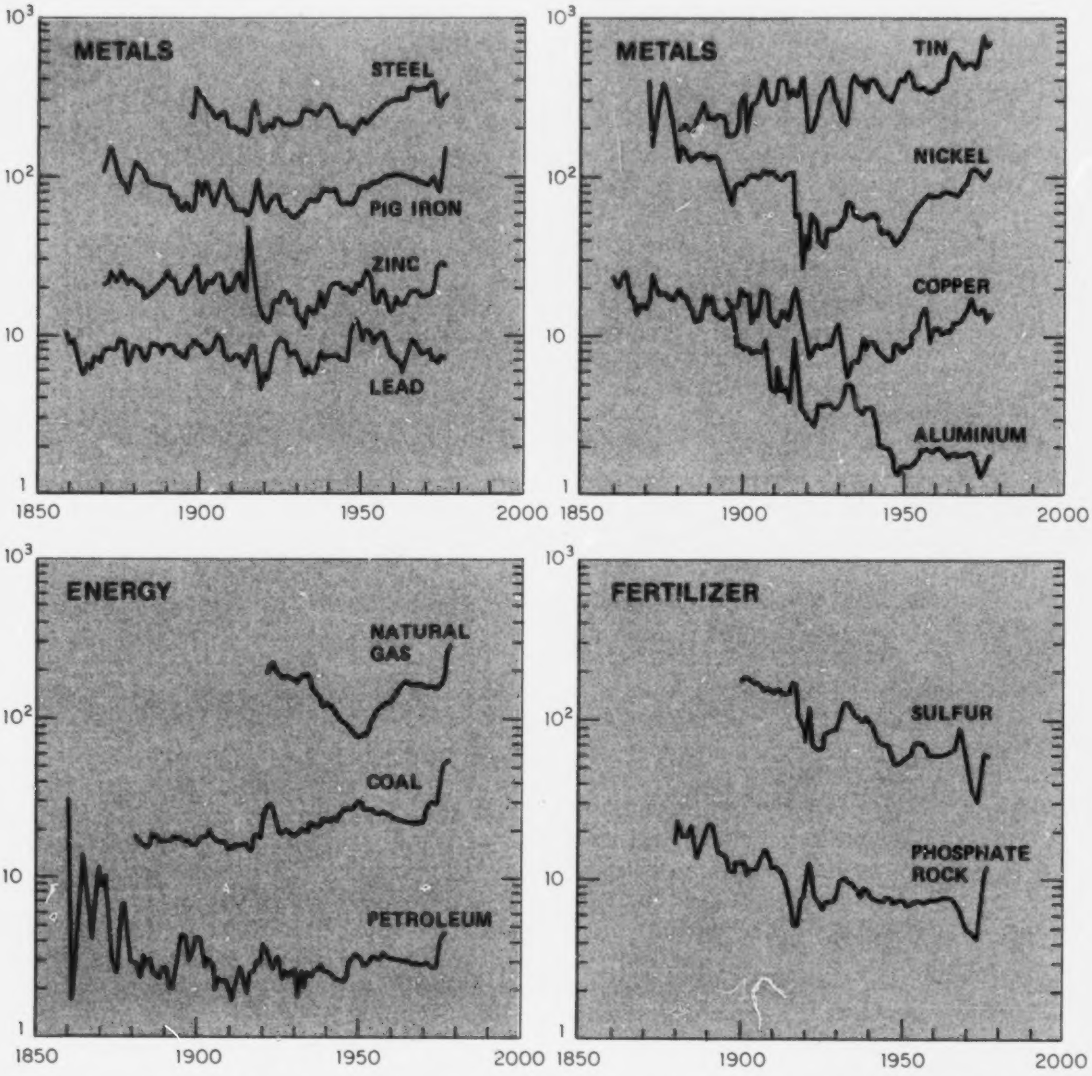
> "In 1900 the lowest grade of copper ore economically minable was about 3 percent; today [1976] the economic cutoff has fallen to about 0.35 percent; at that grade each ton of refined copper produced requires the breaking, transport, and milling of almost 300 tons of rock and, in addition, the removal of perhaps an equal amount of waste or barren rock. A great deal of energy—about 26,000 kilowatt-hours, the equivalent of the energy in about 4 metric tons of Wyoming coal—is required to produce a metric ton of copper today, but the cost of that energy is still low compared to the cost of supporting the equivalent in men and mules."[8]

While more recent studies have qualified the findings of Barnett and Morse, they generally show that at least until 1970 the prices of most major raw materials in the U.S. were no higher in real terms than they had been many decades earlier.[9] This is seen in Figure 1, which displays trends in relative or constant dollar prices (1967 dollars) for eight major metals; for natural gas, coal, and petroleum; and for sulfur and phosphate rock, major components of fertilizer. The graphs do, however, show sharp upturns for some items in the 1970s, particularly for energy and the components of fertilizer.

While prices are better than any other signals of scarcity, they are far from perfect. It is tricky to obtain good measurements of the most appropriate prices and to separate out the effects of inflation, short-run fluctuations, and changes in market regulations and controls. For example, in recent years the

Figure 1. Price Trends for Selected Major Resources: U.S., 1870 to 1977

(Relative prices in constant dollars)



Source: Ulrich Petersen and R. Steven Maxwell, "Historical Mineral Production and Price Trends," *Mining Engineering*, Vol. 31, No. 1 (January 1979), pp. 30 and 31.

Note: For details on converting these prices in terms of 1967 dollars, see the above source.

Organization of Petroleum Exporting Countries (OPEC) has raised world petroleum prices to levels above what they would have been in free markets, while U.S. government regulations have kept domestic energy prices below appropriate world levels. (The shortages caused by production shortfalls during the Iranian revolution have led to the reverse situation in the last few months, with spot market prices rising above "benchmark" prices.)

But the most fundamental problem is that prices exist only for goods traded in markets. Thus, changes in environmental quality and the use of resources like air and water cannot be judged in this way. Indeed, since such environmental resources typically are implicitly priced at zero, the costs of producing raw materials—which generally use disproportionately large amounts of such resources—tend to be biased downwards. Further, prices of raw materials often do not include the costs of cleaning up the pollution incurred in their production. Where more or less effective environmental regulations exist, as in the U.S., businesses typically do have to pay much of the cost of cleaning up the pollution that their production processes generate. But the cost of cleaning up damages occurring before effective regulations were present are typically borne by the whole population in the form of higher taxes. And globally, of course, effective regulation is more the exception than the rule.

Another difficulty is that such market prices may not give adequate weight to the interests of future generations.[10] We leave a heritage of slowly or never-degrading pollutants to our descendants, whose interests are not reflected in the price signals being given producers. Moreover, markets—and those who regulate them—are short-sighted; they often fail to stimulate development of technologies that will be needed relatively far in the future but which require long lead times to bring into production. For example, a serious consequence of keeping the price of petroleum and natural gas in the U.S. below world levels has been the failure to provide adequate incentives to conserve and to search for and develop substitutes in a timely fashion. In addition, problems such as the removal of topsoil through erosion and the buildup of carbon dioxide in the atmosphere might not have economic consequences that affect prices until it is very difficult, expensive, or impossible to deal with them. The health costs that future generations will have to bear because of today's pollution emissions are similarly not reflected in today's market prices.

Specific evidence of depletion

If measures of well-being and market prices are not adequate to reveal if we have been winning or losing the race between demand and resources, the only alternative is to look at what is happening to specific material or environmental resources, to see if there is widespread evidence of depletion in stocks or deterioration in quality. The problem with this approach is that there are no overall, quantitative indexes. Examples of deterioration can be found, but it is difficult to say whether they are omens of approaching global overload or manifestations of transitional, localized, or manageable problems. Examples of improvement can also be found, but it is nearly impossible to strike a balance between them and signs of deterioration. The best we can do is to try to clarify the nature of the confusing situation we face in several important areas.

Renewable biological resources. Recent trends in per capita production of various biological resources have been cited as evidence that human numbers have arrived at the limits of the earth's carrying capacity. A number of these trends are presented in Figure 2 (page 14). A general decline *might* signal the approach of physical limits, but the specifics of each case must be considered before drawing conclusions.

Worldwide per capita production of beef did indeed decline for two years in a row in 1977 and 1978, but this is hardly enough evidence to argue that the trend will be downward from this point on. As can be seen, similar fluctuations have occurred since 1960. Per capita production has also declined for mutton since 1972 and for wool since 1960. But these two trends are related to changes in taste and the development of synthetic fibers which have made it less profitable to raise sheep and supply mutton. If tastes and technologies were to change again or synthetics were to become more expensive relative to the cost of raising sheep, these trends could be reversed.

For wood, the trend in per capita production is clearly downward. Indeed, forestry products are an exception to the general finding of Barnett and Morse that raw material prices have not risen during the last century. Twenty-five years ago forests covered a quarter of the world's land surface. Today they cover only one-fifth and, if present trends continue, the fraction could fall to one-sixth in 2000 and one-seventh in 2020.[11] Most of this deforestation is occurring in developing countries where energy price rises and population growth are intensifying pressures on fuelwood and timber supplies, especially in the delicate ecosystems of tropical forests.

Fisheries, too, are probably overexploited and declining at this time. From 1950 to 1971, the world's total fish catch rose by 5 to 6 percent a year, from 21 million metric tons annually to a peak of just over 70 million metric tons. Production then dropped abruptly to less than 66 million tons in the next two years and has fluctuated generally downward since then. With growing world population, the drop in per capita yields has been even greater. While some nontraditional marine species such as krill could be exploited further, especially for livestock feed, most analysts agree that the traditional fish population is not sustainable without some cutback in the catch. If ocean pollution grows over time, consumption will have to be reduced even further to protect the fish population, though there are no good numbers to indicate the magnitudes involved. The same holds for freshwater fisheries. Inadequate international cooperation has hampered management of ocean fisheries and control of ocean pollution, although the on-going United Nations Law of the Sea Conference offers some hope of correcting this situation.

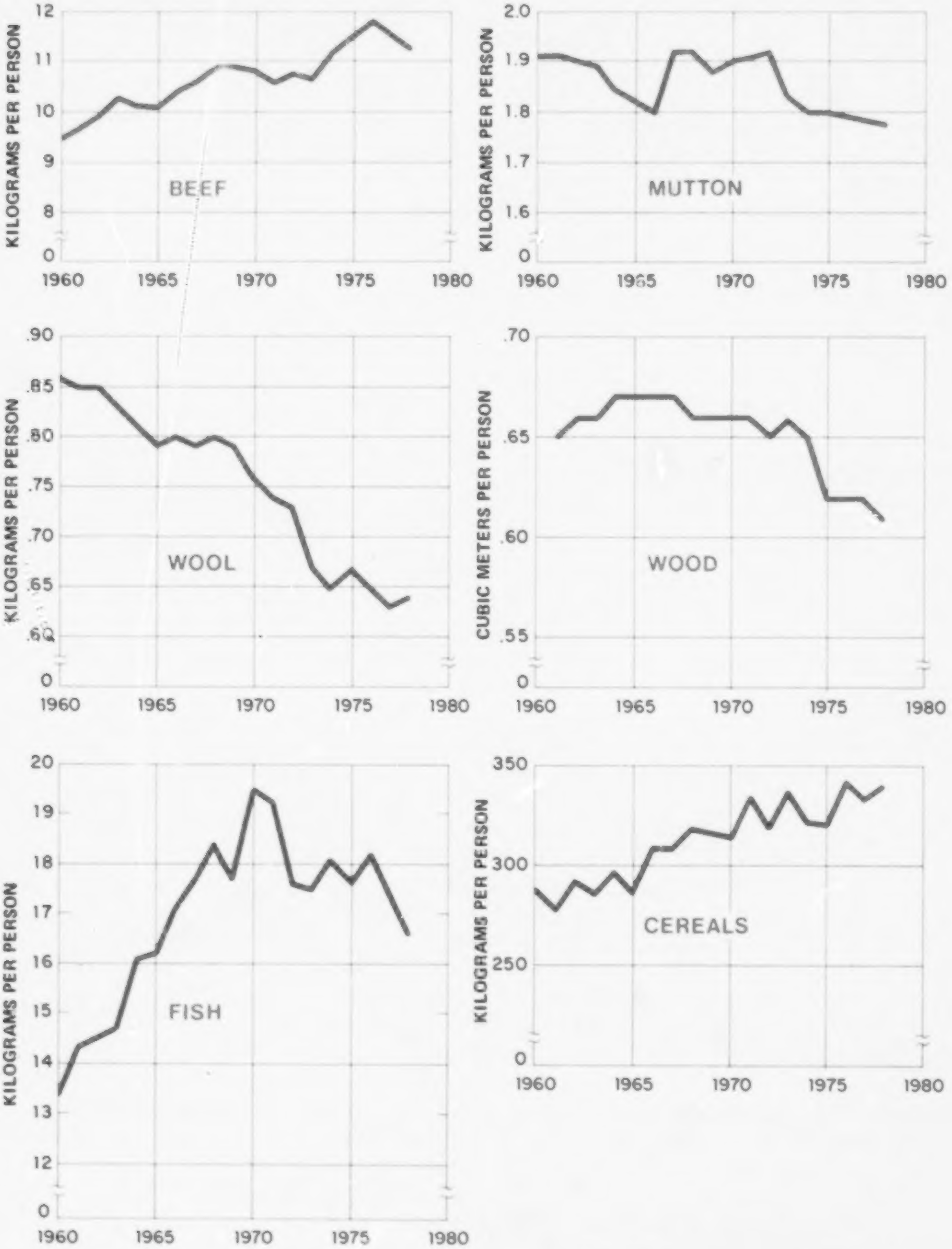
But production technologies are changing dramatically in forestry and fishing. Unlike modern agriculture, these industries were still in the hunting and gathering stage a few years ago. But increasingly, settled farming techniques are beginning to be applied. The change is most marked in the forestry sectors of developed countries. Land in forests in the U.S. has been approximately stable since 1920, despite significantly increased urbanization, and net annual wood growth nearly quadrupled between 1920 and 1977, primarily due to higher yields per acre.[12] In developing countries the situation is far more serious because of encroachments on forest land for other uses and the inability of the extremely poor to wait for trees to grow to optimal size before cutting. But even here isolated examples of successful reforestation and village woodlot programs can be found.[13]

The fishing industry is somewhat further behind in applying farming techniques, in large part because the technological problems are more difficult to solve. But research and commercial efforts in this area are increasing rapidly. Experts see fish farming supplying 15 percent of total U.S. seafood con-

Photo: Government of Malaysia

An example of successful reforestation in Malaysia.

Figure 2. World Production Per Capita of Some Renewable Resources: 1960 to 1978



Source: Lester R. Brown, *Resource Trends and Population Policy: A Time for Reassessment*, Worldwatch Paper No. 29 (Washington, D.C.: Worldwatch Institute, May 1979) Table 1.

sumption by 1982.[14] The potential contribution of fish farming to the scanty protein in Third World diets is still more significant. The Food and Agriculture Organization estimates that, with adequate assistance, management, and control of pollution, fish farming in ponds, rice paddies, and marshes—an ancient and widespread tradition in China and other parts of Asia—could boost inland fishery production worldwide to 50 million metric tons in 2000. Fish farming in saltwater lagoons and estuaries, as now done with young salmon in Japan and the U.S., could be similarly encouraged, provided that the growing pollution of inshore waters can be controlled.[15]

Indications that the rate of growth in per capita production of cereals has declined since 1971 is sometimes taken as another piece of evidence that population growth is pushing against the earth's sustainable biological limits. If true, the situation is serious, for these cereals—wheat, rice, corn, and other grains—directly supply over half the food energy of the world's population and much of the remainder indirectly when consumed as livestock products and alcoholic beverages.

But one's impression of the situation depends on the dates chosen. In the last panel of Figure 2, if one were to draw trend lines starting in 1972 or in 1970 or 1960, it would not be all that clear that data for recent years depart significantly from the upward trend of the 1950s and 1960s. From 1950 to 1971, total world cereal production nearly doubled and per capita production climbed over 30 percent from 251 to 335 kilograms per year. However, losses have been matched by recoveries since 1971, with per capita production actually climbing to a record high of 342 kilograms in 1976,[16] which suggests that it is too early to predict a steady decline from now on.

Between 1950 and 1975 the world's total cropland was extended through irrigation, reclamation, and the conversion of forests, pasture, and rangeland. But these new lands are likely to be less fertile than cropland that has been in use for some time. Moreover, the land lost to urbanization, desertification, and other uses is sometimes above average in fertility. In the U.S., for example, the Environmental Protection Agency has estimated that between 1967 and 1975, 24.3 million acres of cropland were converted to urban and builtup areas and to water uses, and another 54.9 million acres went out of production for other reasons. At the same time, 48.7 million acres of cropland were added, mostly derived from pasture and rangeland. But prime cropland has made up a disproportionate share of the losses to urban and builtup areas while the quality of pasture and rangeland added has been below average.[17]

One can also point to the food shortages of the mid-1960s and early 1970s as evidence of net loss; but these shortages were the result not of global shortages of land or water but of regional droughts, questionable policies, and the absence of global contingency plans to cover lean periods. While droughts were slashing yields in Africa and Asia, American farmers were still being encouraged to withhold land from production; the Argentine government was discouraging production and export by holding domestic wheat prices below world levels; and the Soviet Union suddenly decided to import grain rather than cut back on demand as it had previously done after a poor harvest. Many people have advocated the development of a global reserve of food grains to see the world through such periods, but to this day such a reserve has not been established.

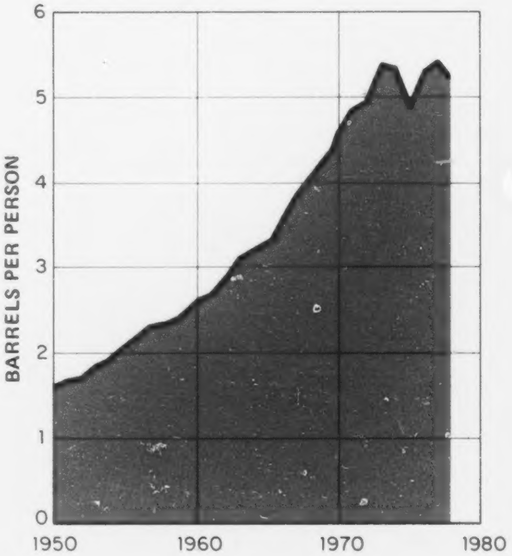
In large measure, the crux of the current problem is unequal distribution of productive capacity and purchasing power. Even with the potential for surplus production elsewhere in the world, the poor countries simply cannot afford to buy adequate quantities of food grains in international markets when their own supplies fall short.

Petroleum. As Figure 3 indicates, the steep climb in world oil production per capita appeared to break dramatically in 1974, and without further evidence one might be inclined to predict a downward trend from now on. The quadrupling of oil prices by OPEC in late 1973, from $2.59 in January 1973 to $10.95 in January 1974, (plus the further increases to approximately $20 a barrel in the first half of 1979), can also be taken as signals of coming shortages. But this picture must be tempered by two factors.

First, a more reasonable explanation for the stagnation in per capita oil production since 1973-74 is that the fourfold price rise constrained per capita consumption (which, apart from inventory accumulation, is equal to per capita production). This difference in intepretation is significant. If the figures after 1973-74 result from depletion of petroleum reserves, per capita production (and hence consumption) is likely to turn steadily down. But if they result from shifts in market power that permitted a unilateral price hike by a major group of producers, the future trend is likely to be flat for a few more years as price-induced conservation efforts take hold and then begin rising again, perhaps a bit more slowly than in the past—unless, of course, oil prices begin again to rise faster than the rate of inflation.

The latter interpretation seems closer to the mark. What appears to have happened—at least in part—is that depletion of working fields in many parts of the world plus discoveries in the Middle East led to concentration of production in the hands of a small group of countries who, for political as well as economic reasons, were able to band together to raise the price. With development of oil fields in Mexico, China, and other developing countries, and in the North Sea, Alaska, and possibly also the Soviet Union, major producers may find it more difficult to act in concert for a time. Eventually, as remaining petroleum resources are drawn down, production could become concentrated again, but not necessarily in the same countries that dominate today's markets.

Figure 3. World Oil Production Per Capita: 1950 to 1978



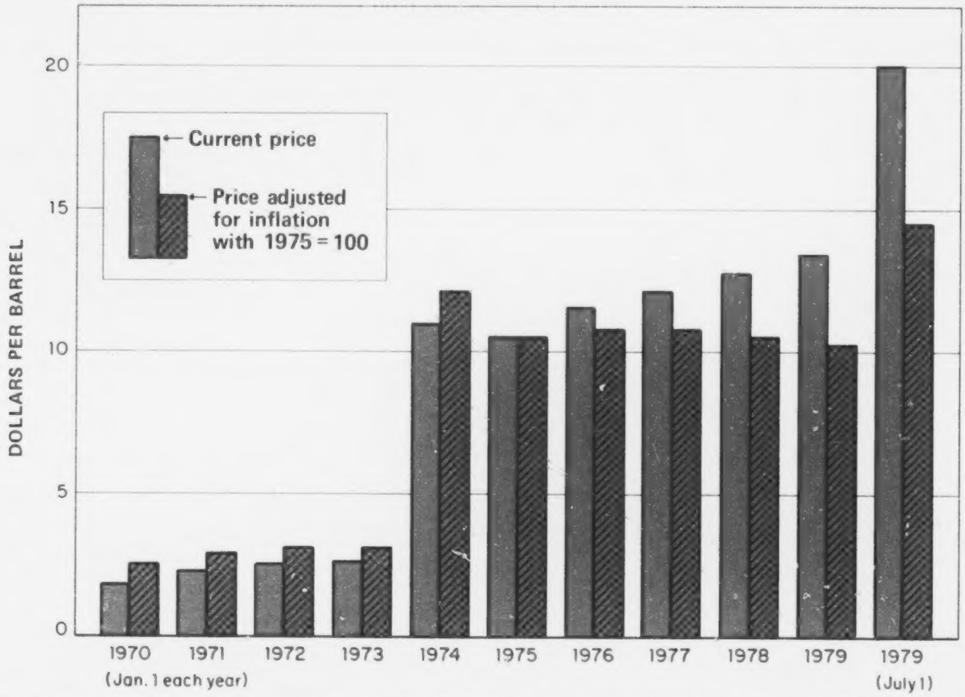
Source Lester R Brown, *Resource Trends and Population Policy: A Time for Reassessment*, Worldwatch Paper No. 29 (Washington, D.C., Worldwatch Institute, May 1979) Figure 2. Reproduced with permission

Second, contrary to what many people appear to believe, the world price of oil, properly corrected for inflation, did not rise much between 1974 and 1979. As Figure 4 indicates, from January 1, 1974, to January 1, 1979, the quoted world price increased from $10.95 to $13.34 a barrel. But other prices rose even more so that on a constant price basis the cost of acquiring a barrel of petroleum actually fell. For the U.S. this fall was about 15 percent; for West Germany, which benefited from the devaluation of the U.S. dollar (the currency required by OPEC in payment for oil), the fall was 29 percent. The shortfall in Iranian production caused by that country's political turmoil has permitted

OPEC to catch up during the first half of 1979, and in June the price was officially raised to approximately $20 a barrel. Corrected for U.S. inflation, this amounts to a 40 percent rise in six months; but it is only a 20 percent increase over the January 1974 price, as demonstrated in Figure 4. Continued inflation and further depreciation of the dollar could wipe out much of this increase if the price is not raised again before the end of 1979. (Note that this discussion pertains to the cost of purchasing petroleum in the world market. The price to U.S. consumers has risen faster in recent months because of efforts to decontrol domestic prices, to allow them to rise to world levels.)

Thus, it cannot be taken as self-evident on the basis of price trends since 1974 that international oil prices are going to rise faster than inflation during the next few years. So long as this is the case, the decline in per capita production (and consumption) that occurred after the dramatic price rise of late 1973 cannot be taken as a sign that the trend is clearly downward from here on. There are indeed very serious dangers in the current world energy situation, but they stem from the fact that importing countries have become increasingly dependent on supplies from a politically unstable area of the world, not from the growing likelihood of imminent exhaustion.

Figure 4: International Oil Prices, Current and Deflated Dollars Per Barrel: January 1970 to July 1979



Source: Ronald G. Ridker and William D. Watson, Jr., *To Choose a Future: Resource and Environmental Problems of the U.S., A Long-Term Global Outlook* (Baltimore: Johns Hopkins Press for Resources for the Future, forthcoming 1980).

Note: **Current price** through January 1979 is for benchmark or marker light oil sold by Saudi Arabia. The July 1979 current price shown is roughly the midpoint of the benchmark price of $18 and the maximum of $23.50 agreed to at the June 1979 meeting of the Organization of Petroleum Exporting Countries (OPEC). Actual market prices can vary substantially. **Deflated price** is the current price adjusted for inflation, using the U.S. "GNP deflator," with 1975 = 100.

Environment. Environmental quality might appear to be one area where deterioration on a global scale is indisputable. Pressure on the environment has indeed increased with economic and population growth. But even here the evidence is mixed.

In any country where pollution regulations are taken seriously, there has been measurable improvement in levels of such mass pollutants as carbon monoxide, particulates, hydrocarbons, sulfates, and suspended solids in water. In the U.S. for example, the Council on Environmental Quality reports that between 1973 and 1976 annual carbon monoxide emissions dropped from 81.3 to 69.7 million tons, or 14.3 percent, as automobile emission controls were enforced in the wake of the Clean Air Act of 1970.[18] But the U.S., like other rich countries, can afford to trade off some economic growth for environmental quality. In most developing countries, safeguarding the environment has so far generally taken second place in the struggle to upgrade living standards. In the short run, food and jobs are more important than wilderness protection or even some health losses due to air and water pollution. This could be shortsighted; prevention is typically cheaper than abatement and cleanup after pollutants are released, and some kinds of pollution can seriously affect production capacity. But this approach is understandable, given the more immediate problems these countries face.

There are other growing environmental problems that no country is yet controlling, in part because methods of economic control are not always known. These include cancer-causing substances released by the burning of fossil fuels, highly toxic trace substances with long half-lives like arsenic, lead, certain pesticides and herbicides, and radioactive pollutants, all of which can concentrate into lethal doses as they move through food chains. And still others such as the buildup of carbon dioxide in the atmosphere are not being controlled because of uncertainty about how serious they really are. Environmental problems like these may be our most threatening legacy from past population and economic growth. We return to them at the end of the *Bulletin*.

The answer?

Clearly, the evidence to answer our first question regarding the balance to date between demand and supply is inconclusive. There are signs of deterioration in the global resource position, but there are also signs of improvement. Some solutions have been found; others have not, or have not been implemented. But considering the fact that welfare indicators have been improving on average; that relative prices of most resources, at least until the 1970s, were no higher than in earlier decades; and that consideration of specific bits of evidence about resource and environmental change is on the whole inconclusive, we are left with at least a weak presumption in favor of the proposition that the world as a whole has been winning the race between growth in demand and supply of resources. But with all the qualifications involved it is a very weak presumption and, more importantly, provides no solid basis for predicting the future—a future that may be substantially different from the past.

Future Demands

This leads to our second question: What is likely to happen to the rate of growth of demand for resources? To answer, it is important to distinguish between rates of growth in population (the lilies in the pond) and rates of growth in per capita demand for various resources (how much each lily consumes of nutrients in the pond), and between rich and poor countries.

Population projections

In more developed, rich countries, rates of natural increase (births minus deaths)

Table 3. Average Annual Rates of Population Growth, 1950 to 1980, and Selected Projections to 2000

Region	1950-55	1955-60	1960-65	1965-70	1970-75	1975-80	Projected 1995-2000
			(Percent)				
World	1.8	2.0	2.0	1.9	1.8	1.8	1.34 - 1.70
More developed	1.3	1.3	1.2	1.0	0.9	0.8	0.45 - 0.60
Less developed	2.0	2.3	2.4	2.3	2.2	2.2	1.62 - 2.00
Africa	2.2	2.4	2.5	2.6	2.7	2.9	2.51 - 2.83
Asia	—	—	—	—	—	—	1.36 - 1.80
East Asia	1.8	2.0	1.9	1.8	1.6	1.3	—
South Asia	1.8	2.2	2.4	2.5	2.4	2.5	—
Latin America	2.7	2.8	2.8	2.7	2.6	2.7	1.92 - 2.40
North America	1.8	1.8	1.5	1.1	0.9	0.8	0.37 - 0.65
Europe	0.9	1.0	1.0	0.9	0.8	0.6	—
U.S.S.R.	1.7	1.8	1.5	1.1	0.8	0.9	—
Oceania	2.2	2.2	2.1	2.0	1.8	1.5	—

Sources: Data for 1950-80 from United Nations, Population Division, "Demographic Estimates and Projections for the World, Regions, and Countries as Assessed in 1978," provisional report, January 25, 1979. Projections for 1995-2000 from Community and Family Study Center of the University of Chicago, World Bank, United Nations, and U.S. Bureau of the Census, reported in Amy Ong Tsui and Donald J. Bogue, "Declining World Fertility: Trends, Causes, Implications," *Population Bulletin*, Vol. 33, No. 4 (Washington, D.C.: Population Reference Bureau, October 1978) Table 14.

have already declined to within striking distance of zero. By 1977, they were actually at or below zero in five countries—the United Kingdom, Austria, East and West Germany, and Luxembourg.[19] The rates could rise again, but considering that the decline is associated with increased female labor force participation and other changes in sexual roles which tend to reduce fertility and which are not likely to be reversed, whatever rise occurs will probably be small and temporary.

Population growth rates appear to have leveled off in the poor, less developed countries as a whole (Table 3). They have fallen significantly in many Asian countries and in a few in Latin America, although almost nowhere in Africa. While a slowdown in declines in death rates accounts for part of this, the more important component has been the beginning of declines in birth rates. In India, Thailand, the Philippines, Indonesia, and Colombia, for example, birth rates are currently estimated to be in the middle to low 30s (compared to 15 in the U.S.), and as low as 24 in South Korea and perhaps 20 per 1,000 population in China. For all these very populous countries, this represents a decline of at least 14 percent since 1965.[20] If the material and social progress of recent years is not reversed and if family planning programs are pursued with no less vigor than they now are in many developing countries, the world's population growth rate is likely to fall, slowly and grudgingly, from this point on. The last column of Table 3 suggests the range within which it might fall by the year 2000. The decline is not so fast as one might hope for, but is better than that projected by the United Nations in the early 1970s.[21]

This decline in the rate of increase is not sufficient to reduce the absolute size of the additions, however. Even the reduced rate of 2000 will translate into some 97 million additional people annually according to the current U.N. "medium variant" population projections[22]—up from an annual increment of about 73 million in the late 1970s. The U.N. medium variant projection of 1978 puts the total global population at 6.2 billion in 2000 (compared to 4.3 billion in 1979) and about 11.5 billion when births and deaths ultimately come into balance and human numbers stop increasing, somewhere about 2075.[23] Thus, even though the *rate of growth* in demands for the earth's resources represented by numbers of people will ease, the sheer *size* of those numbers will still place increasing pressures on material and environmental resources for a long time to come.

Growth in per capita demand

Per capita demands for material goods in poor countries are likely to expand as fast as growth in their incomes permits—which is likely to be faster than growth rates in rich countries, especially since most of the developing countries are just beginning to industrialize, mechanize agriculture and so on—the most resource-intensive phase of modernization. But their incomes are still so low that their demands for resources will not weigh very heavily in total world consumption for some time to come. While less developed countries contain 73 percent of the world's 4.3 billion people in 1979 and will comprise 78 percent of the 6.2 billion now projected for 2000, they currently account for only 20 percent of the world's output of goods and services, and that percentage is not likely to rise to more than 23 percent by 2000.[24]

Of more importance for resource requirements is what happens in rich countries. The best conjecture here is that growth in demands for (and consumption of) material goods will slow down significantly. This is because the rate of growth in per capita incomes is likely to fall and because a declining fraction of income is typically spent on material goods as incomes rise. The slowdown in the rate of labor productivity, and hence income, in developed countries is already under way. It is likely to continue for a variety of reasons, including increasing investments for new forms of energy, environmental controls, additional health and safety requirements, and more of what is sometimes called on-the-job leisure—a willingness to work but only at a more relaxed pace as incomes rise.

Then, too, the quantities of material goods which people demand are likely to rise at a decelerating rate as incomes continue to rise in developed countries. (*Expenditures* may continue to rise with incomes as people purchase more luxurious or sophisticated items, but our concern here is with resource requirements, which are more closely related to the number of units purchased.) This deceleration is partly related to the quantities of goods already possessed. There are just so many cars, refrigerators, and houses that one individual can conveniently own; at some point in the accumulation process he will find that he does not have the time to use and enjoy them. For well established goods like cars and refrigerators, diminishing returns to the possession of more than one or two sets in very quickly; and new goods coming on the market must compete with other possessions for the individual's time, with the likelihood that some possessions will be shoved aside. These diminishing returns are also related to the quantities of goods possessed by others. If I accumulate material goods faster than others do, I feel better off. But if others accumulate at the same rate, my enjoyment may diminish. For some goods like jewelry and designer dresses, snob appeal explains this phenomenon, but for most it is simply a matter of congestion. I cannot enjoy my car (or snowmobile or secluded vacation site) as much when everyone else is trying to do the same.[25]

Putting all these factors together leads to projections of rates of growth in demands for resources that decline significantly over the coming decades. Table 4 (page 22) presents projections of consumption from the Ridker-Watson study referred to earlier which cover the period from 1971 to 2025 for nonfuel minerals and from 1975 to 2050 for energy. As can be seen, they indicate that the growth in total world consumption of energy will slow from 4.6 percent per year in 1975 to 3.6 percent in 2000 and 3.0 percent in 2025. For most nonfuel minerals shown, annual growth rates in total consumption are similarly lower in the 2000-2025 period than they are in the 1971-1985 period.

These projections probably underestimate the slowdown that will occur because they are based on older population projections than those used in Table 3. For example, the U.N. medium variant projection for the world's population in 2000 is now 6.2 billion, as noted, rather than the 6.4 billion used in the projections of consumption in Table 4. The energy projections may not allow sufficiently for conservation which, given appropriate monetary incentives or government regulations, could result in a significant saving. The projections for nonfuel minerals are also likely to be on the high side because they represent demands on virgin materials and assume that recycling—which does not draw on primary resources—will supply the same fraction of total demand that it did in 1973-74, an unlikely occurrence given probable changes in prices, policies, and technologies. In addition, they include only a few of the substitutions likely to occur between less abundant materials (like metals) and more abundant materials (like cement and glass).

There will also be changes in the mix of resources consumed, as seen for energy in Table 4 and Figure 5 (page 23). In the scenario of the Ridker-Watson study used here, it was found that the most important source of energy in 1975—petroleum, which then accounted for 42 percent of commercial energy consumption—would drop to third place by 2025, tied with natural gas, each accounting for 18 percent of the total. By 2050 both would have virtually disappeared. Coal, increasingly used in the form of synthetic liquids and gases, is projected to become the leading source of energy by 2025, although its share of the total in 2050 (36 percent) will not be much above what it was in 1975 (30 percent). These projections assume that nuclear energy will continue to develop and will account for 23 percent of consumption in 2025 and 30 percent in 2050. If public resistance to nuclear reactors continues unabated, these projections will be too high. The percentage contributed by solar energy remains low until after 2025 because this scenario assumes no significant technological breakthroughs or changes in relative costs until after 2000. Needless to say, government subsidies or tax incentives could be used to speed up the development of solar energy and synthetic fuels. Policies that move in this direction have now been formulated in the U.S.

As development advances, the developing countries' share of world commercial energy consumption is projected to grow from 16 percent in 1972, when they accounted for 71 percent of world population, to 47 percent in 2025 when they will comprise 85 percent of global numbers, as seen in Table 5 (page 23). The U.S. share of world energy consumption is also projected to come more into line with its population. In 1972, with just over 5 percent of the world's population, the U.S. consumed 32 per-

Table 4. World Consumption and Rates of Growth in Consumption of Selected Resources: 1971 to 2050

Nonfuel minerals

Resource	Absolute consumption (1,000 short tons)	Annual rate of growth in consumption (%)		
	1971	1971-1985	1985-2000	2000-2025
Aluminum	12,107	6.7	4.8	4.4
Chromium	3,416	2.5	2.5	2.6
Cobalt	44	[illegible]	2.9	3.2
Copper	8,026	2.9	2.1	2.1
Iron in ore	456,183	2.3	2.2	2.3
Lead	4,768	3.1	2.7	2.5
Manganese	2,786	6.0	3.6	3.7
Molybdenum	40	7.4	3.4	3.3
Nickel	657	4.7	3.6	3.5
Phosphate rock	114,913	3.2	2.6	2.0
Potash	21,711	2.8	2.2	1.9
Sulfur	24,251	4.5	3.6	2.9
Tin	257	3.1	2.6	2.8
Titanium	543	9.2	4.5	3.7
Tungsten	23	4.9	2.9	3.1
Vanadium	22	4.7	3.4	3.0
Zinc	5,525	3.3	2.6	2.7

Energy

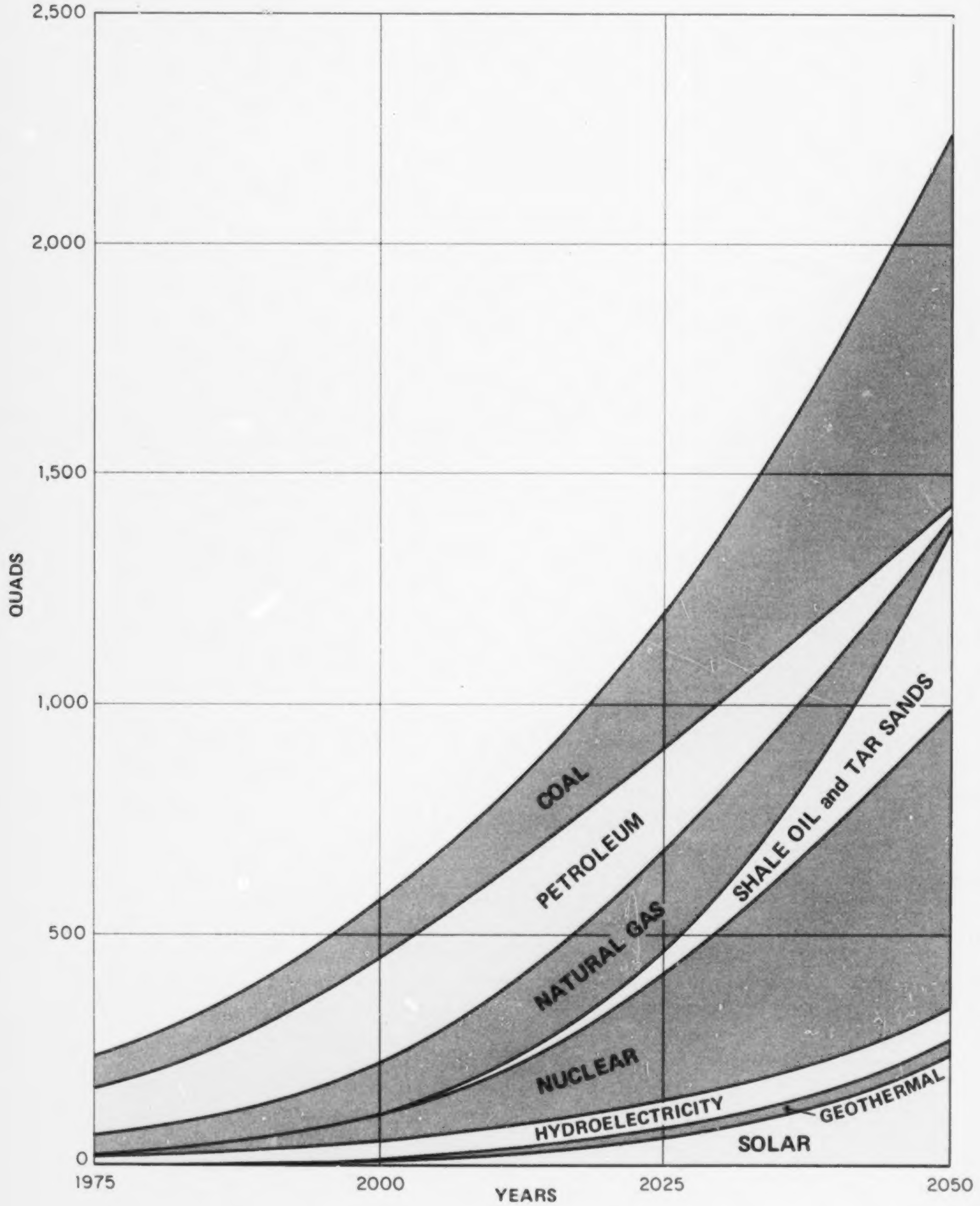
	1975		2000		2025		2050	
	Quads[a]	(%)	Quads	(%)	Quads	(%)	Quads	(%)
Coal	70	(30)	125	(22)	292	(24)	806	(36)
Petroleum	100	(42)	222	(39)	217	(18)	26	(1)
Natural gas	48	(20)	118	(21)	221	(18)	27	(1)
Shale oil and tar sands	0	(0)	—	(—)	50	(4)	378	(17)
Nuclear	3	(1)	58	(10)	276	(23)	666	(30)
Hydroelectricity	16	(7)	41	(7)	63	(5)	69	(3)
Geothermal	—	(—)	4	(1)	22	(2)	32	(1)
Solar	—	(—)	6	(1)	60	(5)	237	(11)
Total	237	(100)	574	(100)	1,201	(100)	2,241	(100)
Annual rate of growth (%) in total (from previous year)	4.6		3.6		3.0		2.5	

Source: Ronald G. Ridker and William D. Watson, Jr., *To Choose a Future: Resource and Environmental Problems of the U.S., A Long-Term Global Outlook* (Baltimore: Johns Hopkins Press for Resources for the Future, forthcoming 1980).

[a] One quad of energy equals 10^{15} British thermal units. This much energy could be provided by 172 million barrels of oil or 37.8 million metric tons of coal.

Note: These projections are based on the "standard world case" from the above source which assumes no relative price increase and no change in recycling rates from the base period.

Figure 5: World Energy Consumption: 1975, 2000, 2025, and 2050



Source: Ridker and Watson, *op. cit.*

Note: See Table 4 for definition of quad

Table 5. Estimated and Projected World Energy Consumption and Population, Developed and Developing Regions: 1972, 2000, and 2025

	1972				2000			
	Energy consumption		Population		Energy consumption		Population	
Regions	Quads[a]	(%)	Millions	(%)	Quads	(%)	Millions	(%)
Developed[b]	188	(84)	1,099	(29)	384	(67)	1,274	(20)
Developing[c]	36	(16)	2,700	(71)	190	(33)	5,172	(80)
Total world	224	(100)	3,799	(100)	574	(100)	6,446	(100)
United States	72	(32)	209	(5)	114	(20)	264	(4)

Source: Ridker and Watson, *op. cit.*, Tables 2-4 and 5-6.

[a] Defined in note to Table 4.

[b] Developed regions include the U.S., Canada, Europe, Oceania, Japan, and the U.S.S.R.

[c] Developing regions include Latin America, Africa, Asia minus Japan.

cent of total energy, but this share is projected to fall to 14 percent when the country's population makes up just 3 percent of the world total, as also seen in Table 5.

In sum, with the projected slowdown in both rates of population growth and rates of consumption of resources, the answer to our second question appears to be that the lilies (population) and their demands on the nutrients in the pond (resources) are unlikely to grow as rapidly in the future. It is true that the *absolute amount* of resources required will increase dramatically. As seen at the bottom of Table 4, world energy requirements could be five times greater in 2025 than they were in 1975 (1,201 quads versus 237 quads). But this increase is still significantly less than what was anticipated just a few years ago.

This leaves us with our third question: What can be said about the size of the lily pond—the resources—and the extent and speed with which it can expand?

Resource Supplies to 2025

The question of resource supplies in the future is vastly more difficult to answer because it requires projections of new discoveries and techniques of production as well as judgments about rates of diffusion and increases in production capacity. Adequate answers are impossible without highly detailed, quantitative studies, few of which have been undertaken. The best we can do here is to discuss two related questions. In this section we deal with the first: Are resources adequate to meet the demands that are likely to be forthcoming during the next quarter to half century? If so, at least we know we have some breathing space. In the next section, we address the second question: Are resources adequate to meet the level of demand that the world might ultimately have to face on a sustained basis? The answer to that question provides some basis

2025			
Energy consumption		Population	
Quads	(%)	Millions	(%)
637	(53)	1,375	(15)
564	(47)	7,990	(85)
1,201	(100)	9,365	(100)
171	(14)	304	(3)

Note: Based on the "standard world case" from the above source

with which to consider what types of solutions are required.

Current and prospective reserves

The notion that resources may be inadequate to meet demands in the near future frequently comes from the observation that known reserves of many resources will be exhausted in only a few decades if current rates of growth in consumption continue. There are three problems with this approach.

The first is that current rates of growth in consumption are unlikely to continue, as we have seen. Still, if we had to rely solely on known reserves, there is little doubt that problems would arise within a relevant time frame. The first column of Table 6 (page 26) indicates this fact by showing the dates when prices would have to rise relative to other prices if currently known reserves had to be relied upon. These projections are based on the rates of growth shown in Table 4 and assume that the prices do not increase until the date indicated and that there are no technological changes in production or changes in recycling rates. On these assumptions, it can be seen that currently known reserves of copper, for example, would be exhausted in 2010, reserves of nickel in 2014, and those of petroleum in 1995.

The second problem with this approach is that "exhaustion" dates like those in column 1 of Table 6 do not take into account the fact that current reserves are only a small portion of the resource base. While they are drawn down by consumption, current reserves are augmented through new discoveries, plus technological improvements and increases in market prices which make it economical to mine less concentrated ores. At a minimum, then, estimates of what is likely to be added to these reserves in a given time period because of new discoveries ought to be included. The second column of Table 6 indicates what happens to the dates when relative prices must rise to avoid exhaustion of the nonfuel minerals and energy resources shown if such "prospective reserves" are taken into account.[26]

Figure 6 (page 26) may help clarify the concepts of reserves, prospective reserves, and resources. **Resources** (the entire box in Figure 6) include all the materials that may someday be used. There are no good quantitative estimates of this concept since they depend on all the discoveries, technological changes, and price changes that may ever occur—factors that cannot be predicted. Estimates have been made of minerals in the earth's crust (the outer perimeter to a depth of one kilometer or one mile) but these numbers are clearly too large because it is inconceivable that every last pound of minerals in the earth's crust will someday be mined.

At the other extreme are **current reserves** (upper lefthand box in Figure 6) for which reasonably good estimates generally exist. These are quantities of

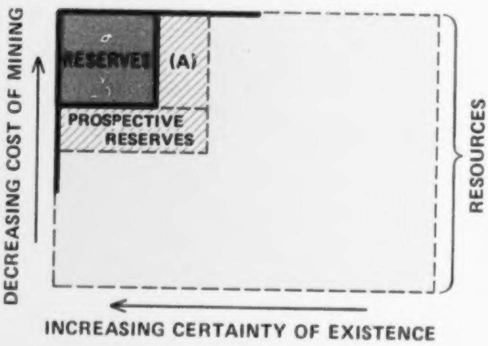
Table 6. Dates When Price Must Rise to Avoid Exhaustion of Selected Resources

	Based on currently known reserves only (year)	Based on reserves plus prospective reserves (year)
Nonfuel minerals		
Aluminum	2025	2038
Chromium	2048	2095
Cobalt	2004	2016
Copper	2010	2041
Iron	2053	2094
Lead	2000	2016
Manganese	2061	2112
Molybdenum	2014	2480
Nickel	2014	2032
Phosphate rock	2034	2120
Potash	2104	2368
Sulfur	2010	2036
Tin	2003	2030
Titanium	2043	2151
Tungsten	2009	2037
Vanadium	2060	2180
Zinc	1993	2065
Energy		
Coal	2050	3000
Petroleum	1995	2010
Natural gas	2005	2024
Uranium	2005	2030-2070

Source: Ridker and Watson, *op. cit.*

Note: These projections are based on the "standard world case" from the above source and assume that recycling rates remain unchanged and that the rate of growth in demand during the 2015-2025 period remains constant thereafter.

Figure 6: The Resource Base



resources that are known and available for economic exploitation with current technologies and at current prices. They are similar to inventories, and since exploration and development are costly, little effort is made to "prove up" new reserves if what is already known is considered adequate to meet demand for the next 10 to 20 years. Even these estimates are incomplete and conservative. Frequently, private companies withhold or underreport such figures. Also, there are many countries for which only incomplete data exist. For example, there are no published data on reserves or prospective reserves of chromium for Oceania, or for copper and phosphate rock in the People's Republic of China.

When current reserves begin to be depleted, the search for additional reserves is intensified. Changes in prices and technology can also affect estimates of reserves. For example, if prices increase or costs of mining decrease, it becomes economical to mine lower grade ores, and the quantities available for current exploitation must be reassessed. **Prospective reserves** is a concept developed to bridge the gap between reserves and resources. It represents estimates of the quantities likely to be added to reserves because of the discoveries and changes in prices and technologies projected to occur within a specified time period. In our case, we limited the term only to discoveries likely to occur during the next half century (portion A of "prospective reserves" in Figure 6).

The third problem with calculating "exhaustion" dates is that this approach says nothing about what is likely to happen when these dates are approached. Certainly the resource in question will not suddenly disappear from the market at that point in time. Instead, its price will begin rising in anticipation of coming shortages, thereby stimulating mining of lower grade ores and encouraging conservation, recycling, and the search for substitutes. In all these ways, demand is dampened and supplies are stretched, thereby smoothing the transition to another resource regime. Obviously, if the price rise is abrupt and steep, serious disruptions could occur. But consideration of the specifics of individual cases suggests that except for petroleum such an event is unlikely—at least unlikely solely as a consequence of depletion of a given grade of resources.

Aluminum

Consider the case of aluminum, which at 8.3 percent is the third most abundant element in the earth's crust (after oxygen at 45.2 percent and silicon at 27.2 percent). While Table 6 indicates that reserves and prospective reserves would be exhausted by 2038 without a price rise, these estimates of reserves are based only on aluminum from bauxite. Given today's technology, the price of bauxite would have to rise by at least 20 percent and perhaps as much as 80 percent (the latter equivalent to a 10 percent increase in the price of finished aluminum) to justify switching to much more abundant nonbauxite sources of aluminum such as clay and shale. But because of technological developments which will improve the efficiency of obtaining aluminum from these sources, this cross-over price is likely to fall significantly over time—certainly before bauxite is exhausted. Thus it is possible, with adequate planning, that nonbauxite sources of aluminum will be phased in as bauxite is depleted so that no serious economic consequences ensue.

Nickel, copper, cobalt

Other examples are nickel, copper, and cobalt, all of which are listed in Table 6 as having hypothetical exhaustion dates prior to 2045. But the reserve and prospective reserve figures listed in that table include only land-based resources. Once seabed sources of these three minerals are added in—which surely will be appropriate to do during the next 25 years or so—the world reserve figures of these minerals could increase enormously. It has been estimated, for example, that prime areas of the ocean floor contain 29 billion dry tons of nodules which in turn contain 435 million tons of nickel, 348 million tons of copper, and 72.5 million tons of cobalt, plus 7.25 billion tons of manganese.[27] And new nodules are estimated to be forming at the rate of 10 million tons per year, although only a fraction of this increase occurs at likely mining sites. Indeed, the future problem with nickel, copper, and cobalt may not be shortages but falling relative prices for land-based supplies of these minerals which could hurt prospects for the developing countries that are major producers, for example Zaire, which produces cobalt, and Peru and Chile, important producers of copper.

Oil

The situation with respect to petroleum is not too dissimilar. In this case, the analysis underlying Table 6 suggests that *in the absence of political constraints* production could keep up with the growth in demand without a real price rise above its current level until sometime between 1995 and 2010 (depending on a variety of assumptions about income and price elasticities, the cost of substitutes, how rapidly they can be brought into use, etcetera). This is not to say that cartel actions or production shortfalls like those occurring in Iran will not increase the price before that date; but thereafter the price *must* rise in order to hold demand in line with production from a diminishing resource base.[28] However, the increase in the price of petroleum will make it profitable to produce synthetic liquid fuels from other far more abundant sources such as oil shale, tar sands, coal, and possibly also vegetation (which can be used to produce alcohol). Given today's technology, it would take a 50 to 90 percent increase in the price of oil to justify the switch to liquid fuels from such sources, but by the turn of the century the necessary increase in price may be more like 10 to 20 percent. Here again, it is not long-term exhaustion we must worry about but the shorter term problems of import dependency and the longer term problems of making the transition from one energy regime to another in an orderly way. Such problems could prove especially difficult for poor countries which are deficient in alternative fuels such as coal. (Of the currently estimated total world resources of coal, 35 percent are found in the U.S.S.R.; 35 percent in the People's Republic of China; and 19 percent in the U.S.) It will take substantial foresight, planning, and good will to forestall these difficulties.

Economic impact of rising prices

But suppose our assessment is incorrect, that in fact resource prices in real terms have to rise quite substantially over the next 50 years to balance demands and supplies. How much impact might this have on the world economy?

Countries with supplies of these resources to export—many of which are developing countries—will benefit, of course, and importing countries will be hurt. But the impacts are likely to be modest, except in small, highly specialized economies such as Zaire (which depends on cobalt), Zimbabwe-Rhodesia (dependent on chromium), and Gabon (manganese). The cost of mineral ores is only a part of the total cost of the metals that are produced from them—11 percent for bauxite, 30 percent for iron, and 60 percent for copper, for example. And these metals in turn are only a small fraction of the cost of finished goods. The same is true with energy (except in the energy sector itself). In the U.S., for example, nonfuel minerals account for less than one-half of one percent of the total output of goods and services, and energy costs comprise less than one percent. In the agricultural sector of the U.S., energy is projected to account for 3.1 percent of production costs in 1985 and would not rise to more than 5.6 percent even if energy prices were to double between 1975 and 1985. The fact that energy costs are still a small fraction of total output in major consuming countries, plus the fact that the petrodollars accumulated by OPEC were recycled relatively quickly, explains why even the fourfold increase in oil prices in 1973 did not reduce economic growth rates by more than 2 or 3 percent in most countries, according to one estimate.[29]

Resource-deficit poor countries, for whom the foreign exchange costs of nonfuel minerals and energy constitute a larger fraction of total output, would be hurt the most by substantial price increases. If large enough, such increases could force these countries to scale back development programs. And energy price increases could force the poor within these countries to rely more heavily on wood, thereby exacerbating tendencies toward deforestation and attendant erosion and flooding problems. The majority of these countries did not fare badly after the 1973 petroleum price increase, largely because of the sizable loans made available to them at the time. But as their debt service burdens continue to mount, it remains to be seen whether loans to cover further cost increases will be as easy to obtain.

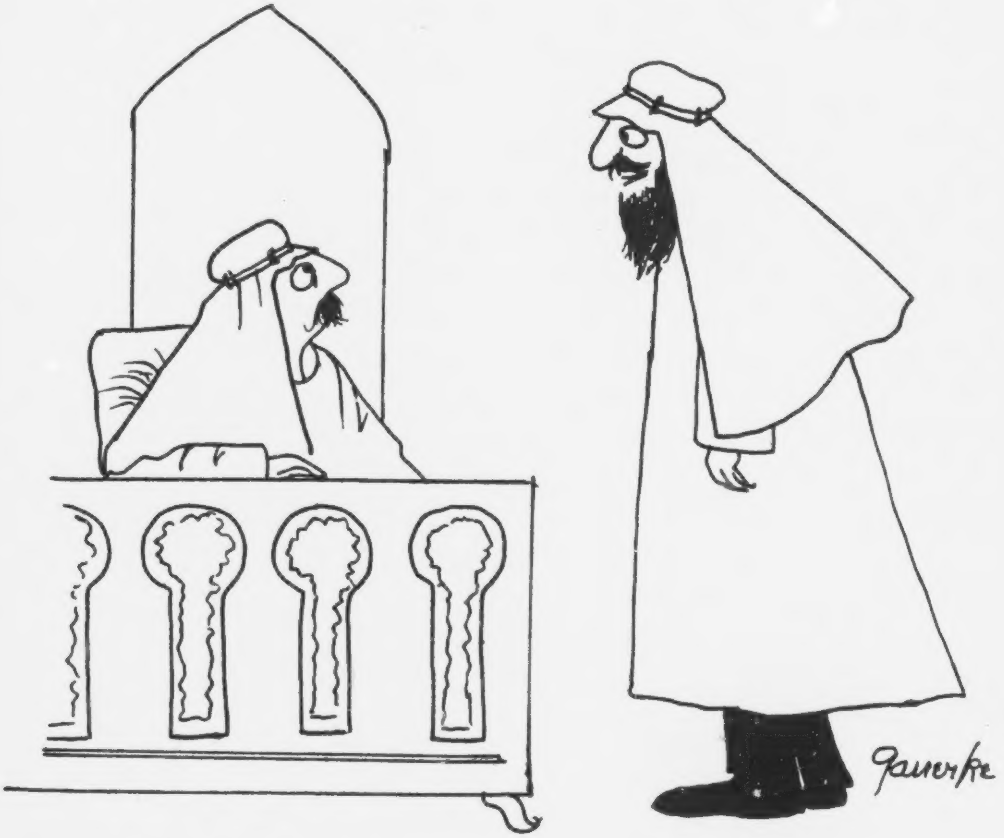
Some have argued that this assessment of the impact of resource price increases does not take into account the greater amounts of energy that will be required as high-grade ores are exhausted and lower grade ores come into use. But the extraction of useful metal from mineral ore involves both mining and "beneficiation" of the ore, and reduction and refining of the metal from the beneficiated ore. Generally the first step requires far less energy than the second. Goeller and Weinberg point out, for example, that "to mine and beneficiate 1 ton of iron from presently used magnetic taconite ores requires about 5 percent as much energy as is required for the total production of steel from ore. Thus, the overall energy required is not very sensitive to the grade of ore until the ore becomes extremely dilute."[30] They go on to explain that the use of such diluted mineral ores will not be necessary. In the long run, most of our metal needs can be supplied by iron, aluminum, and magnesium, all of which are extractable from essentially inexhaustible sources. (As noted, aluminum is the third most abundant element in the earth's crust. Iron, 5.8 percent of the earth's crust, is the fourth, and magnesium, 2.8 percent, is the sixth.) Still more importantly, Goeller and Weinberg find that the energy required to produce these metals from such inexhaustible sources is in each case not more than about 60 percent higher than the energy required to win the metals from more concentrated high-grade ores.

The attempt to supply necessary resources during the next quarter to half century could lead to capital shortages during some periods, however. On the one hand, investment requirements to develop new sources of minerals and energy and (at least in industrial countries) to meet new environmental and health standards are likely to rise substantially. In the U.S., for example, requirements for developing new sources of energy are alone expected to increase from 6.3 percent of total capital needs in 1972 to 9.5 percent in the mid-1980s before dropping back to more normal levels.[31] On the other hand, uncertainties over the course of future prices of minerals and energy, the terms on which exploitation can occur in many countries, and local opposition to the siting of nuclear power plants and mines appear to be growing. The result could be a reduction in venture capital at just the time when investment requirements are at their highest, with inflation and shortages during some periods, even though in a physical sense the resources are there to be exploited.

Overall picture to 2025

There is, of course, a good deal of uncertainty in the picture we have sketched of resource supplies during the next half century. Estimates of reserves and of rates of additions to reserves are poor. Technological developments, such as nuclear fusion that could guarantee energy supplies for centuries may come along sooner or later than we think. After the near-meltdown of a nuclear reactor at Three Mile Island near Harrisburg, Pennsylvania, in the spring of 1979, and especially if such accidents are repeated, the U.S., and perhaps other countries as well, may decide not to live with the risks of nuclear fission. Cartels controlling sources of supplies can be established or break up. Environmental problems, which we discuss at the end of this *Bulletin*, could be severe.

Our point in this section is a limited one: that depletion of minerals and fuels and rising world resource prices are not the central problems we face in the next half century. Rather, we face transitional problems—problems of adjusting to increased oil prices, problems of bringing new energy and mineral sources on stream in an orderly fashion, and problems associated with changes in the global distribution of suppliers as new reserves of resources need to be tapped and the balance of power shifts as a result.



"Before they get the idea to hike their wheat prices to the degree we've hiked our oil prices, I propose we buy the State of Iowa."

Gaurke in the *National Review*, 150 East 35th St., New York, NY 10016

While these problems are in part a legacy of the population and economic growth that has occurred so far, they will not be greatly affected by likely changes in these growth rates during the next half century. The Ridker-Watson study found that cumulative energy requirements from 1975 to 2025 would be reduced by 8 percent if the world's population were to grow to 6.7 billion rather than 9.4 billion in 2025, a decline of 29 percent, and by 16 percent if world GNP per capita were $2,600 instead of $3,900 (both in 1971 dollars) in 2025, a decline of 33 percent. Much of the reason for this difference in response is the fact that a slowdown in *population* growth rates would mean an increase in the rate of per capita economic growth, which would partially offset the decline in energy requirements due solely to changes in population, while a slowdown in *economic* growth has far smaller feedback effects on population growth. Indeed, if there is any effect it is likely to be in poor countries where population growth might be reduced by the fall in the standard of living because of a rise in the death rate. But the impacts on energy requirements of each of these changes taken independently are relatively small. It would take the combined impact of slowdowns in both population and economic growth rates to make a more significant difference. If, for example, both the reductions discussed above were to occur simultaneously, a 25 percent savings could be achieved over the 50 years to 2025. But even then, because of the enormous magnitudes involved, that 25 percent savings could be used up in four or five more years of population and economic growth. (Needless to say, a slowdown only in U.S. population and economic growth rates would accomplish even less; indeed, within the limits that the Ridker-Watson study experimented with, it would save little more than a year's worth of global energy consumption in 2025.) Thus a slowdown in population growth, particularly if it came along with a slowdown in economic growth, would buy a little time with which to find solutions—and that could be very important—but by itself it does not constitute a solution.

Ultimate Resource Production Possibilities

But what lies beyond the next quarter to half century? Suppose, for example, that world population reached an equilibrium of 10 to 12 billion, roughly in the range projected by the United Nations, as noted above. Could such a population be sustained more or less indefinitely at a reasonable standard of living, utilizing currently known technologies?

Food production

So far as agriculture is concerned, two points can be made which suggest that this question can be answered in the affirmative.

First, agricultural production takes place in the world in a wide variety of ways. The Japanese, for example, have achieved high productivity levels by using relatively little land but a great deal of labor and chemical inputs. In contrast, the U.S. uses little labor but a great deal of land and mechanized inputs to achieve similar productivity levels.[32] Both approaches, however, are based on a highly developed scientific infrastructure and substantial inputs of energy. Given these two ingredients, there appears to be sufficient flexibility in agricultural production techniques to achieve reasonable levels of productivity in most countries.

The second point has been made by Roger Revelle.[33] He asked how many people could be fed if yields comparable to those obtained by Iowa corn farmers—which are not the highest in the world—were achieved globally on all arable land. Without utilizing arable land in the humid tropics, which has special problems, his answer is that 7.6 billion people could be supported on a minimum subsistence diet of 2,500 kilocalories per day. But if the problems of utilizing land in the humid tropics can be solved, a diet of between 4,000 and 5,000 kilocalories per day (including high-quality protein and "protective foods" such as fruits and vegetables) could be achieved for from 38 to 48 billion people. (The average American today consumes 3,400 kilocalories per day.) Such levels of output may never be feasible because of organizational and institutional limitations. But this exercise is useful to make it clear that sheer availability of land and water is not the central problem in feeding the world's growing numbers. Rather, it is the disparities in the distribution of people on the one side and production capacity on the other, plus the barriers that stand in the way of eliminating these disparities. By production capacity we mean the whole package of inputs necessary to produce adequate quantities of food—scientific know-how, trained manpower, and adequate institutions, as well as land, energy, water, and other physical inputs.

Nonfuel minerals

The situation with respect to nonfuel minerals is similar. There is no danger that the world will "run out" of minerals as a whole. The question is whether more abundant minerals can be substituted for the less abundant without substantial increases in cost. With three exceptions, Goeller and Weinberg argue that they can; that societies can subsist on nearly inexhaustible minerals with little loss of welfare.[34] Detailed studies of cadmium, zinc, lead, copper, tin, and mercury indicate that materials such as iron, aluminum, silicon, magnesium, and titanium can be substituted in practically every use; and other studies find that these abundant materials can be acquired from lower grade ores which are in nearly inexhaustible supply, provided that sufficient energy is available at reasonable cost, both economic and environmental. In addition, glass and cement from virtually unlimited sources (sand, clay, gravel) and plastics and some minerals derived from renewable wood and plant sources can be substituted for many of the minerals that might eventually be exhausted.

The exceptions—important resources which are not in inexhaustible supply—are fossil fuels (oil, natural gas, and coal), phosphorus, and a few elements which are essential in trace amounts for agricultural production, such as copper, zinc, and cobalt. While reserves and prospective reserves of coal, phosphorus, and these trace elements are adequate for hundreds of years, they cannot be considered inexhaustible. Ultimately, phosphorus and the trace elements may have to be reserved for agricultural use and returned to the soil by recycling agricultural and animal wastes, and perhaps even bones. But fossil fuels cannot be recycled; eventually, a replacement must be found even for coal.

In addition to substitution, recycling can stretch supplies of nonfuel minerals. This also has the advantage that the energy required to put materials back into productive use is generally less than that needed to reduce and refine ores. Goeller and Weinberg point out, for example, that for magnesium the remelt energy is 1.5 percent of the energy required to win the metal from virgin ore; for aluminum it is 3 to 4 percent; and for titanium it is 30 percent.[35]

Energy

Thus, the key to the long-run sustainability of life on earth is energy. If there is sufficient low-cost energy and if it can be utilized without adverse environmental effects, land can be reclaimed, seawater can be desalted, fertilizers produced, lower grade ores mined,

World Bank photo by Ray Witlin

Harvesting oil palm fruit in Papua New Guinea. Solving the problems of utilizing land in the humid tropics would help feed growing global numbers, providing disparities in the distribution of people and agricultural productive capacity can be overcome.

metals recycled, and substitutions made between minerals so that a reasonable standard of living can be sustained on a long-term basis. If not, an eventual deterioration in the standard of living is inevitable.

According to Goeller and Weinberg, a reasonable standard of living for 10 billion people would require 60 terrawatts of energy a year.[36] This figure compares to about 7.5 terrawatts used today and is about 1/2000 of the energy absorbed from the sun. Can a 60 terrawatt world be reached and sustained?

Nonrenewable sources of energy. Although world resources of *petroleum* and *natural gas* are likely to be essentially exhausted in the next 50 to 75 years, *shale* and *tar sands*, which are widely dispersed about the globe in what are estimated to be very large quantities, could extend the role of oil considerably longer, providing their environmental problems can be solved. *Coal*, used directly or converted to synthetic liquid fuels and gases, could alone supply the energy needs of 10 billion people for several hundred years.

Nuclear fission is a method of producing steam to generate electricity from uranium, a nonrenewable resource. Current estimates of ultimately recoverable uranium vary widely, partly because there has been little incentive to explore for lower grade ores. If the lowest of these estimates is correct, 15 percent of this resource will remain in 2025; if the highest, 77 percent. *Breeder reactors* could improve this situation. These can make use of all the nuclear energy of the common uranium-238, unlike today's light water reactors which depend on uranium-235 which constitutes less than one percent of natural uranium, and this would in effect multiply nuclear energy resources by a factor of 100. However, breeders would substantially reduce global security because they produce vastly more plutonium—a necessary ingredient in atomic weapons—than do the light water reactors now in use.

Renewable and virtually inexhuastible sources. *Nuclear fusion* has generally been regarded as a prime hope for an inexhaustible source of energy in the future, but it is still unknown whether useful energy at an affordable cost can ever be obtained through this procedure. The task is mindboggling: a mixture of heavy hydrogen gases must be brought up to 100 million degrees Celsius, many times the temperature of the sun, and kept there long enough for energy-releasing reactions between hydrogen nuclei to yield a net output of energy. The principal advantage of fusion is that its raw materials (for example, deuterium and lithium) are available in virtually unlimited supply in ocean waters. But it is not true, as once believed, that fusion is completely free of the radiation and waste disposal problems associated with fission.

Even if fusion at reasonable cost never becomes a reality, a global population of 10 billion could probably be supported by *solar energy* in its various forms. The solar energy incident on earth each day is more than 1,000 times the amount of commercial energy now consumed daily. But sunlight varies from place to place, during different periods of the day and year, and with weather conditions. This complicates the process of collecting, storing, and converting solar energy into usuable energy. However, fixed-location solar collection systems are already operating on a small scale in many countries and could eventually supply as much as 60 percent of residential and commercial requirements for space conditioning and water-heating. Eventually, also, it might be economic to convert solar energy into electrical energy using conventional collectors, ground-based systems based on arrays of photovoltaic cells, or possibly even systems based on photovoltaic arrays mounted on satellites orbiting through space.

Solar energy can also be utilized through its conversion into combustible fuels by photosynthesis in trees, plants, and algae. It is possible that significant amounts of man's energy needs could in time be met by synthetic fuels such as ethanol or methane produced from organic matter (biomass) grown in "energy plantations" on land or at sea, or from organic wastes from agricultural and forestry operations and urban trash. Brazil, with its program to fuel vehicles with ethanol produced from sugar cane, is already moving in this direction.

Wind, tides, thermal gradients between the ocean's warmed surface and cooled depths, and hydroelectricity provide other indirect means of tapping solar energy. Of the four, hydroelectricity is by far the most widely used today in countries well endowed with falling water such as Canada, Norway, the U.S.S.R., and Japan. Estimates put hydroelectricity's worldwide potential at about 110 quads of energy per year, but it is unlikely ever to provide more than 7 percent of the world's energy requirements, the same proportion which it provides today. High costs, land use problems, competing claims for the water, and environmental problems are likely to inhibit its rapid development.

Geothermal heat stored in water pockets or dry "hot rocks" below the earth's surface is a final potentially large source of more or less inexhaustible energy. Hot rocks alone, though now not economically exploitable, are estimated to contain as much energy as all currently estimated nonrenewable energy sources worldwide other than coal.[37]

The economic cost of tapping any or all of these potential sources of inexhaustible energy is virtually impossible to calculate. If reliance had to be placed on a combination of nuclear fission and solar energy today, the cost of energy might have to triple. Some day these costs will come down (in real terms) as researchers dig into these problems. But what they might be after a century of research is anybody's guess.

The environmental and other side effects of using 60 terrawatts of energy each year are likely to be more serious, and some may eventually prove to be intractable. These consequences, then, may be the ultimate key to whether a global population of 10 billion is sustainable at a reasonable standard of living.

Environmental Constraints and Risks

We have reserved most of our discussion of environmental and related problems to this section because they do not fit easily into specific time periods and because some of them, we suspect, might in the end prove to be the most severe and difficult to resolve of all the problems the world faces in coming decades.

It is convenient to group these problems into three categories. The first includes those problems that can be controlled at reasonable cost with current technology, in particular the mass pollutants of air and water like particulates, sulfates, hydrocarbons, carbon monoxide, and suspended and dissolved solids. The second category covers other environmental problems whose impacts are mainly local or national in scope. Examples here are conflicts over land use, including siting of power plants and mining operations, water shortages, nuclear reactor accidents, disposal of spent nuclear fuel, local weather modifications, and soil erosion. The third group involves problems that are more global in scope, for example, global climate changes, nuclear proliferation, and ocean pollution.

Problems capable of control at reasonable cost

If pollution emissions per unit of output were to remain constant in the future, environmental concentrations of the mass pollutants would soon rise to intolerable levels in many regions of the world, affecting not only amenities but also the productivity of labor, land, and fisheries. But most of these emissions can be controlled at modest cost. In the U.S., for example, we have estimated that, without controls, the cost of pollution damages would have been the equivalent of 8.6 percent of the Gross National Product (GNP) in 1975. But actual damage costs in 1975 were closer to 3.2 percent of GNP because of control policies costing about 1 percent. With the enforcement of environmental laws already passed, such as the National Environmental Policy Act of 1969 and the Clean Air Act of 1970 and its subsequent amendments, plus anticipated changes in the next two decades, pollution damage and control costs in the U.S. are projected to amount to 1.5 percent and 2 percent of GNP respectively by the year 2000. These figures allow for some slippage from strictly enforced standards when resource pressures mount. A case in point is the Environmental Protection Agency's suspension in May 1979 of its ban on a gasoline additive which increases hydrocarbon emissions in order to allow more unleaded gasoline to be produced during the gasoline shortage. If there were no such slippages, pollution damage and control costs in the U.S. might be more like 1 percent and 3 percent of GNP, respectively, in 2000.[38]

Thus, for this category of environmental problems, pollution control policies are more important in determining what happens than are population and economic growth rates. In countries where these policies are weak, pollution problems can be expected to mount at least as fast as the growth of GNP, that is, much faster than the growth of population alone. But in countries where stringent policies are applied, these problems can be reduced to acceptable levels at costs that are relatively modest compared to the value of total output.

Photo by Harold M. Lambert

Solar collection systems could eventually supply as much as 60 percent of residential and commercial requirements for space-conditioning and water-heating.

Other domestic environmental problems

Problems in this category differ from those in the first group in three ways.

First, either the technologies or the institutions for controlling these problems are not as well worked out. In most countries there is considerable room for improving efficiency of water use, but the institutional mechanisms for allocating water among users are seldom well developed. Methods of controlling soil erosion are well known but difficult to apply because widely dispersed farmers have incentives to maximize short-run production and, if necessary, to compensate for erosion losses by using more fertilizer, adding marginal lands, and reducing fallow periods. Land reclamation procedures for arid regions pose special problems that are not yet solved. The probability of nuclear accidents cannot be reduced to zero any more than can that of accidents in coal mines; yet the more accidents there are, the more difficult the siting problems will become.

Second, many of these problems will show up in conflicts among local groups or between regional and national interests: for water rights, for power plant and mining sites, for conversion of agricultural lands, and so on. While difficult to predict, these conflicts could at times become so severe and widespread that national economic growth is affected.

Third, until solutions are found to these problems, they are likely to mount with population and economic growth, unlike what we expect in the case of most mass pollutants. For example, Ridker and Watson found that if the U.S. population in 2025 were 28 percent less than the 304 million projected in one of their scenarios, there would be 12.5 percent less land disturbed by mining, 25 percent fewer electric power plants, and 23 percent fewer nuclear power plants, and thus many fewer occasions to arouse local opposition to environmental threats.

Potentially severe global problems

Frequently mentioned examples of global concerns regarding the environment are changes in global climate, ozone depletion, ocean pollution, and nuclear proliferation. In addition, there are a variety of potentially serious regional problems that could have global repercussions. Among these are the loss and deterioration of soils, loss of genetic variability due to the spread of monoculture, release of long-lived radiation from uranium mill tailings, nuclear reactor accidents and problems of waste storage, and the proliferation and buildup of toxic chemicals in food chains.

For a variety of reasons, virtually all the problems in this category are unlikely to be effectively controlled in the near future. In some cases, control is technically and institutionally difficult. Ultimately, for example, the spread of nuclear weapons depends only on the diffusion of relevant knowledge and this is almost impossible to control. Controlling the worldwide increase in nuclear power plants—which itself may be impossible—may thus only marginally delay the spread of nuclear weapons. It may be possible to control the buildup of carbon dioxide in the atmosphere from increased burning of fossil fuels but only by herculean means involving global agreements to capture it from stack gases, reverse the trend toward deforestation which removes the trees to absorb it, and, in the end, perhaps reduce combustion itself.

But these difficulties are frequently compounded by insufficient knowledge to judge whether controls are needed at all and, if so, how strict they should be. Do carbon dioxide and the spread of fission reactors have to be controlled, or can we wait, hoping that less environmentally damaging alternatives such as solar and possibly nuclear fusion energy will come along before these problems become acute? What level of risks are we really subjecting ourselves to when we allow more nuclear plants to be built; and how do they compare with those we accept in other areas like coal mining and with those we could face in the absence of nuclear power, such as a drop in living standards? Then, too, it is difficult to mobilize support for such actions. Even with the same facts, countries with little coal and no oil are likely to view the risks and benefits of nuclear energy quite differently from the U.S.

As a consequence, these environmental pressures can also be expected to increase with population and economic growth. Whether they will become so severe during the next half century as to limit such growth is an open question. They could if the more pessimistic assumptions about carbon dioxide and the risks of nuclear power prove to be true, or if a number of these types of pressures act in concert to overload ecological systems. But little confidence can be placed in these —or any other—assumptions.

The carbon dioxide problem provides a good illustration of the extent of our ignorance. Historically, approximately half the carbon dioxide released by combustion of fossil fuels has remained in the atmosphere. If this fraction continues to apply in the future and population and economic growth continue, atmospheric concentrations of carbon dioxide would rise to about twice preindustrial levels by 2050. According to one relatively sophisticated climate model, that increase would, through the "greenhouse effect," raise the average global temperature by 1.5 to 3.0 degrees Celsius. Such a rise, unprecedented in recorded history, would force dramatic shifts in the global distribution of plants, animals, and man himself; shift storm belts to different areas; reduce the productivity of ecosystems; and eventually begin to melt polar ice and thus raise sea levels. But the estimate of a 1.5 to 3.0 degree increase is based on a model that ignores a number of factors. Higher temperatures would increase evaporation and thus cloudiness would block out incoming heat, and other air pollutants such as particulates could also reduce global temperatures. On the other hand, still more carbon dioxide may accumulate as higher temperatures reduce the capacity of oceans to absorb it; and recent studies by ecologists suggest that deforestation has been so widespread that land plants on net have been releasing rather than absorbing carbon dioxide.[39] Taking these factors into account provides a range of possible dates when a 1.5 to 3.0 degree increase in temperature might occur which extends from as early as 1990 to perhaps never.[40] This is hardly a useful basis for policy decisions.

Similar uncertainties surround the impact of nuclear power generation. While it is known that large doses of radiation can kill a person almost outright and small doses lead to cancer immediately or many years later, the long-term effects of small doses of radiation on large human populations are not known. The relationship between genetic disorders and low-level radiation is also obscure. It is known that radiation increases the rate of mutation but the eventual effects of a mutation depend on additional complex genetic and environmental factors which vary widely for different mutations. Moreover, our experience to date with nuclear power is so limited that it is impossible to evaluate with confidence the probabilities and seriousness of accidents or to determine how to safely store spent nuclear fuel for the thousands of years that it must be isolated from the human environment. No spent fuel has been permanently disposed of yet by any country.

These are all areas of extreme uncertainty and high costs of error. The growth of such uncertainties and risks might be slowed somewhat by restricting population and economic growth. But they cannot really be reduced except by getting on with the task of developing alternatives to fossil fuel combustion and nuclear fission, finding ways to store and safeguard nuclear wastes, and improving our knowledge of carbon dioxide transport mechanisms and the biological effects of radiation.

Implications

Consideration of this array of both shorter and longer term problems should lead one to question the usefulness of both the Limits and the Cornucopian views of the future of man. During the next quarter to half century, the world will be faced with a series of transition problems requiring the substitution of one resource regime for another—in particular from reliance on petroleum

Photo by Harold M. Lambert

A potentially severe global problem is the buildup of carbon dioxide in the atmosphere from increased fossil fuel combustion.

and natural gas to other fuels. In the process, some countries and groups within countries will be hurt while others are benefited. This could cause tensions which, like shifts in the earth's plates that cause earthquakes, eventually burst to the surface. All the while, uncertainties and risks of the type just discussed will undoubtedly mount. As a consequence, the earth could become an increasingly dangerous place to live.

Population and economic growth play important roles in exacerbating these problems in those cases where other means of resolving them are not present or are not adequately implemented. For example, in countries with strictly enforced pollution control policies, economic and population growth need not generate significantly greater quantities of pollutants; and in countries with the capacity to develop synthetic liquids and gases from other available resources, the depletion of petroleum and natural gas reserves should not be a cause for great alarm. More generally, the greater a country's scientific and institutional capacity to resolve problems, the higher the sustainable rate of growth can be without overloading the system. As a consequence, the linkage between population and economic growth on the one hand and resource and environmental problems on the other tends to be looser in developed countries and tighter and more unforgiving in developing countries. But rapid rates of population and economic growth cause at least some problems everywhere. What can be done about them?

Should population growth be restricted? Certainly, for this would slow the speed with which all the problems we have discussed must be solved and reduce the ultimate size of the global population which will have to be sustained, once zero population growth is reached. An equilibrium population of 10 billion in place of the 11.5 billion now projected by the United Nations would present that many fewer problems for the long term. A smaller one would be still better. But even a cessation of population growth cannot resolve all these problems or keep them from mounting over time.

Should per capita economic growth be restricted? Unlike a cessation in population growth, the consequences of an economic slowdown are ambiguous. On the one hand, it would help in the same sense as a slowdown in population growth, by providing more time to find solutions. On the other, it would mean less trained manpower and less surplus output that could be diverted to search for and implement solutions.

Each new birth brings with it an additional packet of resource and environmental problems. In contrast, economic growth can be utilized for different ends than it is put to now. While it adds to the problems that need solution, it also adds to the capacity to solve problems.

Moreover, considering poor countries' legitimate aspirations for a decent standard of living and the unwillingness of the rich to voluntarily redistribute wealth on any significant scale, a slowdown in economic growth is likely to lead to conflict. If nuclear power continues to spread, the results could be devastating. From this perspective, the risks of restricting economic growth may be substantially greater than the environmental and resource problems associated with its continuation.

Should greater efforts at conservation of resources be made? By all means, again on the grounds that it buys time. Indeed, if taken seriously, it should be a better buy in the next decade or so than a slowdown in population growth, whose consequences will take more time to be felt. Turning the thermostat down in winter and up in summer and installing thicker insulation shows up almost immediately in lower monthly oil consumption and bills. Moreover, it appears that considerable savings in energy consumption can be had without sacrificing either personal comfort or economic growth.[41]

But in the end, all these problems will remain until they are directly confronted and attacked. Uncertainities about the effects of more carbon dioxide in the atmosphere can only be reduced through fundamental research into climatology and related fields. Risks associated with nuclear fission can only be contained through improved security measures and efforts to find and adopt acceptable alternatives. Poverty-stricken countries and impoverished groups within countries can only be helped by lifting the barriers to the flow of resources, knowledge, and technical and managerial skills into, and/or people out of, these regions, and so on.

There is no simple explanation for these problems; equally, there are no simple solutions. We have no choice but to work on both the causes and the symptoms simultaneously. Understanding the true nature of the world's resource and environmental limitations is a first step in that direction. ☐

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The 1980 Census: The Counting of America

By Peter K. Francese

Abstract—Centered on April 1, 1980, the 20th decennial census of the United States comes at a time of rapid demographic, social, and technological change, coupled with growing public and private demands for accurate population data while at the same time public suspicion of federal government activities has increased. This *Bulletin* describes the Census Bureau program for meeting these challenges and conducting and making available the results of an operation that will attempt to reach some 80 million households with a mailed questionnaire and cost nearly $1 billion. It examines in detail the questionnaire itself and the planning that went into it; the Census Bureau plans and programs for eliciting public cooperation and finding everybody in an effort to increase coverage even beyond the estimated 97.5 percent coverage of the 1970 Census; how the 1980 Census results will be processed and published, how they can be obtained, and their importance for public programs ranging from Congressional reapportionment and federal revenue sharing to local services planning, and for private businesses of all kinds; and the census geography and revolutionary computerized address coding systems devised by the Census Bureau which make it possible to handle a census of this size largely by mail. The conclusion briefly discusses plans for the first U.S. mid-decade census in 1985 and summarizes the issues that will make the 1980 Census "the most dramatic, important, and closely observed in U.S. history."

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The 1980 Census: The Counting of America

By **Peter K. Francese**

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Mr. Francese wishes to acknowledge the editorial assistance of Bryant Robey, Editor, and Penelope Crissman, Copy Editor, of American Demographics *magazine, and the helpful comments received from Conrad Taeuber in the preparation of this* Bulletin. *Further, the* Bulletin *would not have been possible without the cooperation and assistance of a large number of people at the Bureau of the Census. However, the responsibility for all opinions expressed herein and any errors or omissions rests with the author.*

The most popular television program ever, "Roots," had an audience of only about half of all U.S. households. But the Census Bureau will attempt on April 1 of 1980 to reach every single one of the estimated 80 million American households and get them to fill out a questionnaire for our country's 20th decennial census. That is the goal, at least.

In reality the goal is never quite reached, just as no other activity can ever reach 100 percent of a people as diverse, mobile, and independent as Americans. In the 1970 Census, 97.5 percent of the population was counted, as nearly as Census Bureau researchers could estimate, with proportionately more blacks than whites being missed. For 1980, the Census Bureau will hire more than a quarter of a million enumerators and spend almost $1 billion to see that the coverage of what are expected to be about 222 million people is even closer to the elusive 100 percent.

The reason the government is trying so hard to count everyone lies in the high value census information has for our complex and changing society. Population and housing statistics from the decennial census and the estimates based on them in the intervening years have become an integral part of planning for virtually every government program and every consumer product or service.

The 1980 census will provide a statistical snapshot at a time of unprecedented demographic change. The U.S. birth rate is now the lowest it has ever been; life expectancy is rising. The South and West have become the nation's growth areas, and there is migration out of the older population centers of the Northeast and North Central states. Total U.S. population is growing by less than 1 percent a year; but households are growing at over 2 percent a year. The 1980 Census will measure these trends with a precision that cannot be achieved otherwise, will provide data to clarify the trends, and thus give us all a basis for adjusting plans and programs accordingly.

The background

The clarity of the snapshot, of course, depends ultimately on the cooperation of the people who fill out the questionnaire. It also depends on the skills and experience of the Bureau of the Census. The Census Bureau has had considerable practice in counting people. There have been decennial censuses since 1790 but in the early decades they were rather ad hoc affairs when compared with today's efforts. Censuses were conducted by U.S. Marshals until special census agents were hired for the first time in 1880. Since we were an essentially rural and lightly populated country during our first 100 years, the census was far from the massive operation it has become.

But with the turn of the century came the realization that accurate national statistics were essential to the functioning of a growing industrial nation. The Census Bureau was permanently established in 1902, was made part of the Department of Commerce and Labor in 1903, and was assigned to the newly created Department of Commerce in 1913. In addition to taking the decennial Census of Population and Housing, the Bureau conducts the Economic Censuses, a Census of Agriculture, and a Census of Governments every five years, as well as hundreds of surveys, some as often as once a month.

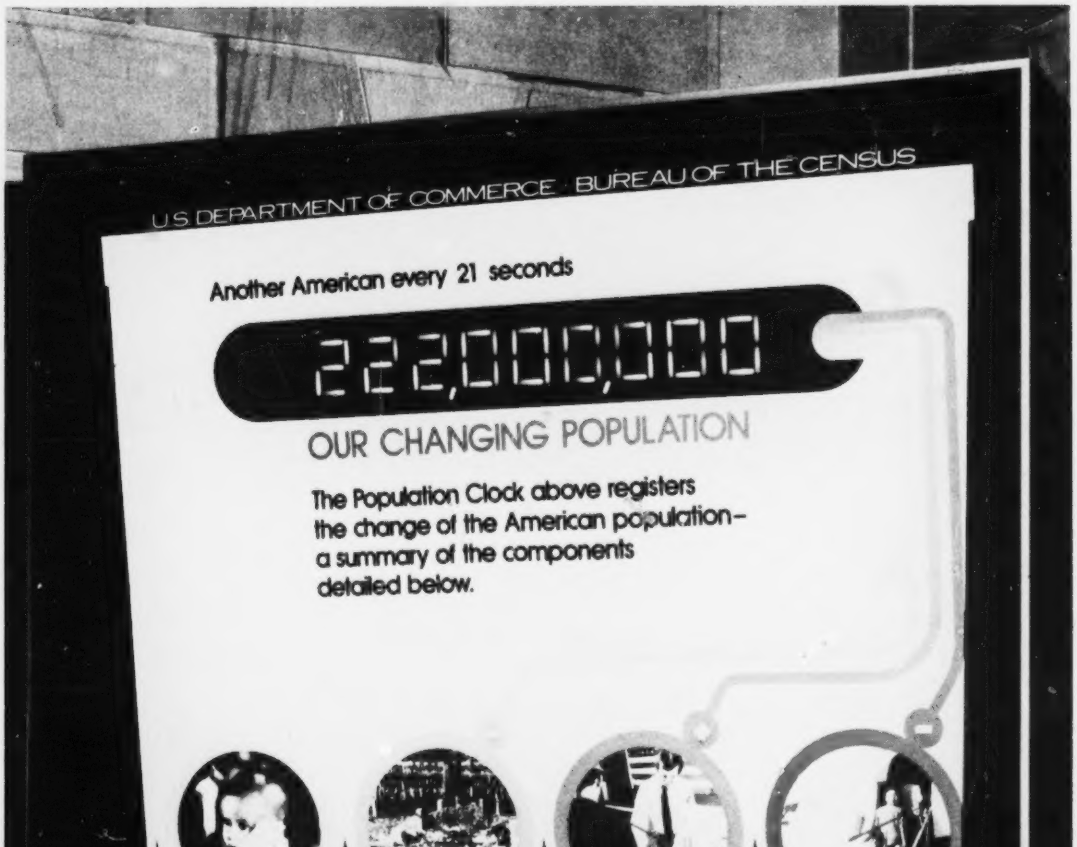
Taking the census balances the government's need to have statistical information against the citizen's right to privacy. The same law (Title 13, U.S. Code) that requires public cooperation with the census also protects the confidentiality of individual information. Respecting privacy is thus translated into the Census Bureau's pledge of confidentiality, a cornerstone of citizen cooperation. Information on individual census questionnaires is used for statistical purposes only and any data that can be linked to any individual are not given or sold to anyone.

Persuading the public of this fact in 1980 may prove more difficult than in the past, given the distrust of the federal government that has arisen in recent years and the rapid developments in computer data storage and processing. Although civil libertarians warn of the potential dangers of collecting and storing census information on individuals, they agree that never has the Census Bureau allowed such data to find their way into the records of other agencies or even to be seen by them. Nevertheless, public perception does not necessarily make distinctions among branches of the federal government.

Why a census?

That census statistics are vital not only to federal agencies and large corporations but also to the general public is beyond question. They determine the apportionment of seats in the House of Representatives and are the basis for drawing political boundaries for state legislatures as well as local election districts. In addition, they are used to allocate more than $50 billion each year from the federal government to state and local governments. These allocations affect the level of services to people and, therefore, the local and state taxes they must pay.

Beyond reapportionment, the program most directly tied to Census Bureau statistics is revenue sharing. Since its inception in 1974, the revenue-sharing program alone has dispensed nearly $40 billion to approximately 39,000 local governments. The allocation is based on a complicated formula which weighs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222,000,000
OUR CHANGING POPULATION
The Population Clock above registers the change of the American population– a summary of the components detailed below.
A BIRTH every 10 seconds
A DEATH every 16 seconds
AN IMMIGRANT every 81 seconds
AN EMIGRANT every 15 minutes

On Census Day, April 1, 1980, the reading for the total U.S. population on this clock at the Department of Commerce Washington D.C. headquarters is expected to be about 222 million.

several factors. Two of the more important are population and per capita income—both provided by the Census Bureau. Some people may think the Bureau is snooping when it asks how much money they made last year, but the information, in statistical form, is an essential ingredient in the formula for what is certainly the largest federal program to assist local governments.

The Census Bureau faces its greatest problems getting cooperation in inner cities, where suspicion of government data collectors is greatest. Many of our nation's cities have been in difficult financial circumstances for some time. A complete census will do more to assure them of their fair share of federal funding than any single event for the next decade, barring a dramatic shift in urban policies. On the other hand, failure to support the census will almost certainly result in further handicapping municipalities in their struggle to combat urban decay. It is a dilemma.

Showing people that they should take the time to inform themselves of the importance of the census is probably the Bureau's biggest task. To begin with, it is the Census Bureau's job to prepare an easily understandable questionnaire, make it available in sufficient quantity, and to provide assistance to people who need help in filling it out. After the census, it is the Bureau's responsibility to tabulate the statistical data. The U.S. Postal Service has been assigned the task of delivering the questionnaires and picking them up, like any other piece of mail, for all but 10 percent of the country, where census enumerators will collect the completed forms. The news media will be provided with a full-scale publicity campaign with which to inform everyone that the census is taking place and that it is important for everyone to fill out the form.

But, the respondent has the most fundamental responsibility of all—to fill out the questionnaire and put it into the mailbox. In the end, the responsibility for a successful census rests with every American. Census Director Vincent P. Barabba has said, "Everyone has a right to be counted, but you can't force people to be counted."

Complete census coverage in the nation's cities will help assure them of their fair share of federal funding.

Planning for the Census

Although the census comes to public attention for only a few months every decade, it is virtually an around-the-clock operation for several years. Its magnitude can scarcely be grasped, nor the incredible detail required to achieve accuracy. We like to think that computers can solve our biggest problems in only a few seconds. The Census Bureau's computer will work for 2,000 hours just to prepare the addresses used to mail the questionnaires. And, if you were to put all the questionnaires end to end, they would stretch more than 38,000 miles—around the equator one and a half times, and a little further.

It will cost between four and five dollars per person to take the 1980 Census, a substantial increase over the previous census. About one-fourth of that some $1 billion will be spent on improving the coverage—trying to find every household and person in the U.S. and count them.

Planning the questionnaire

The first effort in planning for the census is, of course, to provide a simple, easy-to-complete questionnaire that is as short as possible but provides reliable and needed information. To this end, the Census Bureau began as early as 1974 to gather suggestions on what should be asked and what information was no longer needed. After more than 70 public meetings across the country, some questions were dropped and several more were added. For example, there is no longer a need to ask people whether they have a television set in the home; virtually every household has one. Questions on appliance ownership were also dropped. But several questions were added to try to measure total shelter costs, reflecting a need for better data in the face of rising housing costs.

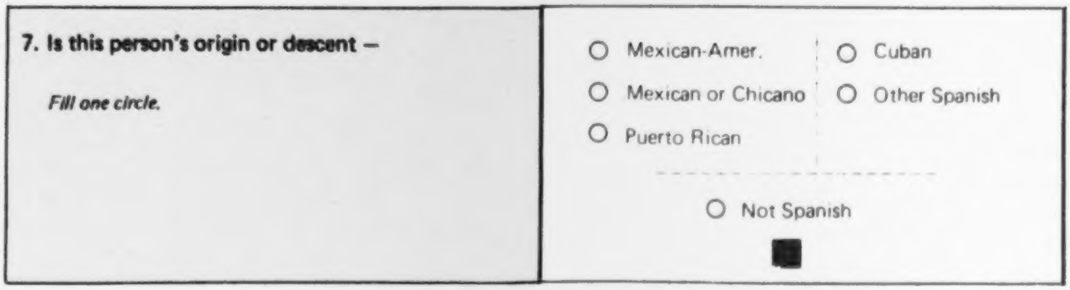
Beginning in 1975, the Census Bureau conducted several national tests of the content of the questionnaires. Different questionnaires were mailed to selected groups of 14,000 households to test response rates and validity of the data. In addition, the Bureau ran several tests of enumeration methods to find the best ways of distributing and collecting questionnaires and improving coverage. Along with about ten of these content and methods tests, four small-scale censuses were conducted in Travis County (Austin), Texas, Camden, New Jersey, Oakland, California, and Puerto Rico to test various aspects of census-taking procedures. Finally, three "dress rehearsal" censuses, conducted in two rural Colorado counties, in Richmond, Virginia, and in the Lower Manhattan section of New York City, tested and evaluated virtually every detail of the census plans. Throughout the process, items of the questionnaire and census procedures were reviewed with an eye toward disposing of those that did not test well.

As a result of the tests, the wording of some questions was changed to make them more easily understandable, while several questions were dropped because it was found that they did not produce reliable data. An important question that changed as a result of testing is one on Spanish origin that had recently been added to the census 100 percent questionnaire.

In the Richmond dress rehearsal, this question produced unacceptably high non-response rates. It was then revised for the later dress rehearsal in Lower Manhattan and, in addition, a national test was done by mail in which half of a sample of 6,500 households was given the Richmond version and half was given the Manhattan version. The result was that the question format used in Lower Manhattan substantially reduced the non-response rates, and that version was finally used. The Richmond test and

Figure 1. Spanish Origin Question

Richmond Test Version



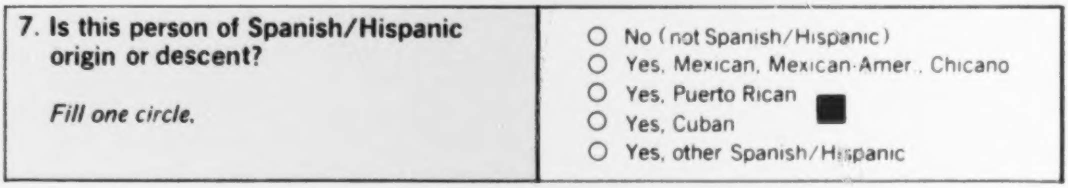
7. Is this person's origin or descent –

Fill one circle.

○ Mexican-Amer.
○ Mexican or Chicano
○ Puerto Rican
○ Cuban
○ Other Spanish

○ Not Spanish

Final 1980 Questionnaire Version



7. Is this person of Spanish/Hispanic origin or descent?

Fill one circle.

○ No (not Spanish/Hispanic)
○ Yes, Mexican, Mexican-Amer., Chicano
○ Yes, Puerto Rican
○ Yes, Cuban
○ Yes, other Spanish/Hispanic

the final version of the question are shown in Figure 1. There is no doubt that the statistical information obtained from this question will be better because of the extensive testing and evaluation procedures.

Also tried out in the tests was a new set of housing questions designed to provide some indicators of housing quality or structural condition. Analysis of the results showed that questions such as "Does this house have open cracks or holes in the interior walls or ceiling?" did not add very much information about housing quality and they also aroused some unfavorable reaction. Consequently, the new housing condition questions were omitted from the final questionnaire.

Also proposed was a group of questions to measure shelter costs for homeowners, such as mortgage payments. These questions tested well and produced reliable results, with the exception of one that asked if there was a property improvement loan. So few households were able to answer that question that it was omitted from the final version which, however, includes seven questions on shelter costs, as seen on page 5 of the reprinted questionnaire *(Bulletin* page 21).

All testing was finished and evaluated by the end of 1978. The year 1979 is reserved largely for printing the millions of questionnaire forms and compiling the address lists used to mail the questionnaires distributed by that method.

Finding everybody

In preparation for the census, the Bureau creates a complete list of all places where people live or might live, an obviously important element in a census by mail. The heart of such an operation is the address list, prepared by a commercial vendor, then checked and corrected three times by the U.S. Postal Service—and further checked and corrected by the Census Bureau. In the 1980 Census, procedures similar to those in 1970 will be used to create the address list. Several firms which offer lists for sale bid to supply the Bureau with initial address lists, and the completeness of each one is a major factor in determining which lists are purchased. For areas where commercial lists are not available, the Census Bureau creates its own with its own field staff.

The Census Bureau estimates that its preliminary address list or "inventory" will amount to about 86 million "dwelling units" (including apartments and rented rooms) but that checking will reveal that about 6 million of these units are unoccupied. Therefore, it is expected that the questionnaires mailed on March 28, 1980, will go out to about 80 million households.

As a final check on the address list, census enumerators, just prior to the mailing of questionnaires, will systematically recheck their assigned areas, identifying any occupied dwelling units that have been missed and adding them to the list.

U.S. CENSUS
FIELD DIVISION

Census enumerators follow up on questionnaires not mailed back within two or three weeks of Census Day or those arriving with incomplete information.

Enumerators are also responsible for seeing that completed questionnaires are returned for every address in their areas. Where questionnaires arrive with missing information, enumerators will phone or visit until all questions have been answered. To track down questionnaires not mailed back within two or three weeks of Census Day, they will make up to four calls at the home, leaving behind written requests for an appointment when nobody responds.

In about 10 percent of the United States, people do not have addresses that can be readily coded by computer to a specific block or census tract. These largely rural areas are enumerated by the "conventional" method. At every household, the Postal Service delivers an unaddressed questionnaire which instructs the respondent to hold the completed questionnaire until an enumerator picks it up several days later. In these areas, it is the enumerator who puts on the questionnaire, by hand, the proper census geographic coding, as described in the section on "Census Geography" (page 30).

The Census Bureau also has special procedures for finding people in institutions of all kinds and transients who could be missed in the questionnaire mailing to households—migratory workers, street people, and those in missions, motels, campgrounds, and so forth. On "T-night" (transient night), the evening before Census Day, Tuesday, April 1, 1980, there will be a special enumeration of people in hotels and motels that charge more than $4 a night, and in YMCAs, YWCAs, campgrounds, and the like. These people are enumerated on "individual census reports" which are sent back to the locality of their permanent addresses. "M-night" (mission night), scheduled for the Tuesday evening of the week following Census Day, seeks out people in mis-

DONT
WALK
FRANKFURTERS
SAUSAGES

Special procedures are used to enumerate people who may be missed in the questionnaire mailing to households.

sions, flophouses, and places charging transients $4 or less a night, and those in local jails and detention centers which hold persons for 30 days or less. It also covers bus and railroad stations and other places where people without addresses are likely to be sleeping overnight. In the final census statistics, such people—like college students living in dormitories—are "allocated" to the area where they happen to be at the time of Census Day.

Another special enumeration procedure, called a Casual Count, is conducted only in large cities. It begins the week before follow-up operations and is designed to enumerate people without fixed addresses who may have been overlooked. Such persons can be found on street corners, in pool halls, bars, etc. One can assume that enumerating these folks is not the most sought-after job at the Census Bureau.

It is clear that a census by mail does not rely entirely on the Postal Service to deliver the forms and bring them back. The checking and follow-up procedures described above are an essential part of the census objective—find everybody.

The Minority Statistics Program

Since the 1970 Census, several new programs have been developed to increase coverage among those people who live in crowded urban areas, are members of a minority group, or may not be fluent in English. The Census Bureau has established the Minority Statistics Program to help convince minority groups that census statistics are valuable to them as well as to Washington and to obtain their cooperation in improving the quality of census data through more complete enumeration of minorities.

There are three components of this new program. Under the *National Services Program*, Census Bureau staff meet regularly with national minority organizations such as The Urban League, The League of United Latin American Citizens, and the Pacific Asian Coalition. Numerous meetings are held each year, at which Bureau officials give presentations on the uses of census statistics and hold discussions on how to improve census coverage.

A second component is the *Community Services Program*, under which the Census Bureau is involved with minority groups at the local level. This program is carried out by 200 community service specialists hired by the Bureau to enlist local minority groups' participation in the census. The goal of this grass roots program is to reach those people who are hardest to enumerate and who would most likely be missed entirely without this special effort.

Along with the above programs, the Census Bureau has set up three minority advisory committees to get advice on how to improve coverage among all minority groups. There are now Census Advisory committees for the Black Population, the Asian and Pacific Islander Population, and the Spanish Origin Population. There have also been a series of meetings with American Indian groups.

Critics say such efforts amount to little more than an attempt to placate minority groups that are critical of the Census Bureau's performance and that the effect of these new programs will be minimal because they do not go far enough. Still, they represent important and expensive additions to the government's efforts to locate and count all Americans, regardless of economic status or race. There is little doubt that the Census Bureau is sincere in its attempt to reduce the difference between white and minority response rates, a source not only of inaccurate data but also of national embarrassment.

Local review

An important new program for 1980—the local review program—should improve the count for minorities and whites alike. Under this program, the chief elected officials in each town, city, and county will be provided with preliminary dwelling-unit counts just prior to the census and will also be given population and housing counts as soon as possible after the census for each block or enumeration district in their municipalities. Thus, each municipality gets two chances to review the census counts before the census is over. The field offices of the Census Bureau will be kept open longer than in past censuses to review areas where the municipality provides evidence of an enumeration problem. Considering that every hour the huge field staff is kept on the job costs the government more than $200,000, even a few additional days will make this a very expensive program. The money will be well spent, however, if it increases community confidence in the census results and corrects problems that would not otherwise be found.

Processing the Census Results

After the census enumerators have reviewed the last questionnaire and checked out the last problem, the completed forms for the 1980 Census will be sent to one of three processing centers. In 1970, Jeffersonville, Indiana, was the sole site for processing questionnaires. Two temporary centers have been added to that permanent facility for 1980, one in Laguna Niguel, California, and one in New Orleans, Louisiana. At these centers, all questionnaires are microfilmed.

One copy of the microfilm is sent to the Census Bureau facility in Pittsburgh, Kansas. Any person may request from that office a certification that they personally were counted in any particular census. Thus a person about to become 65 years old but without any birth certificate may obtain proof of his or her age for social security purposes by showing that they were counted in the 1920 Census when they were five years old—another good reason to be counted in the census.

A second copy of the microfilm questionnaire is processed through a device called "FOSDIC," which optically senses the locations of the pencil marks the respondent made when filling out the form, and transfers the marks to computer tapes which are used to tabulate the data for each piece of census geography. Names and addresses are not read by the FOSDIC system and hence do not appear on these tapes. The result is several hundred reels of computer tape which contain all of the basic individual population and housing

The Census Bureau processing center at Jeffersonville, Indiana, is one of three to which completed questionnaires for the 1980 Census will be shipped for microfilming after checking at the 409 temporary census district offices.

data collected in the census.

Even though these tapes contain no names, they are highly confidential, kept under guard, and are not released to any other federal agency or any public or private organization. Instead, they are further processed into aggregate data tapes and printed reports which can be, and are, made publicly available since the identity of any specific individual is then impossible to determine. In areas small enough to allow for the possibility that a single person's data might be inadvertently revealed by any tabulation, the data are suppressed. For example, in a census block with only three or four persons, the computer would suppress all data tabulations where the aggregate statistics might reveal one of the person's individual characteristics.

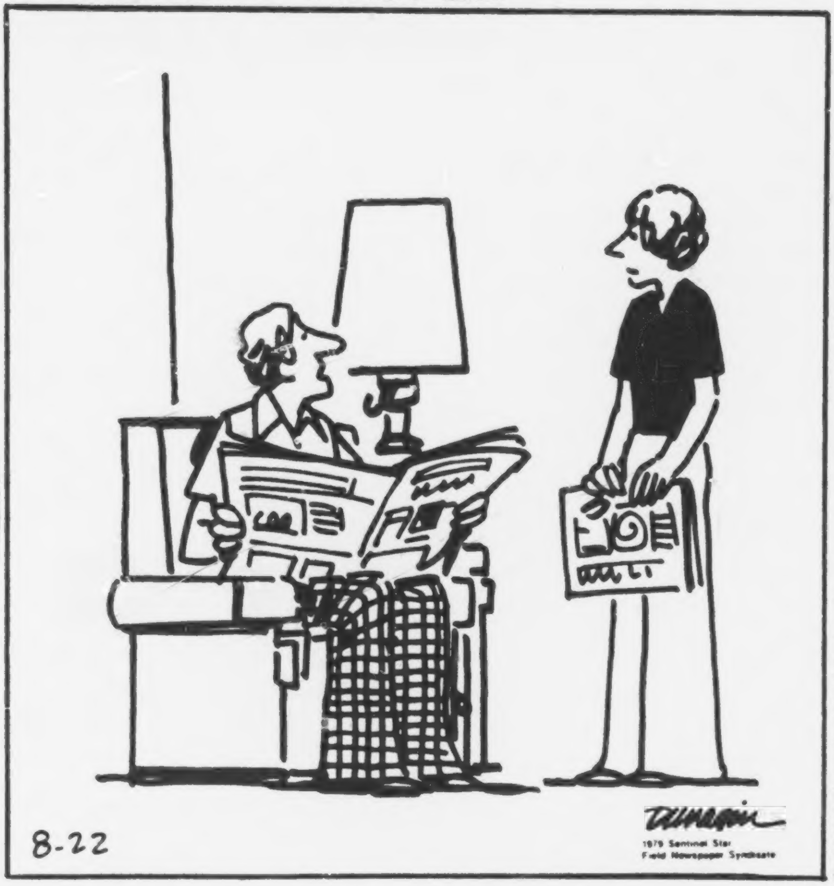
By Thursday, January 1, 1981, the Secretary of Commerce must deliver to the President official population counts for each state, thereby setting the number of members in the House of Representatives that will come from each state. Thus, the major portion of the census-taking process—delivering some 80 million questionnaires, collecting them, finding people not included in a mailed questionnaire, going through local review, processing the data, and creating the basic census tapes—will take only nine months. Most of the printed reports and publicly available computer tapes will be available within 12 to 18 months after the President has received the reapportionment figures.

Uses of the Census

Although reapportionment of representation in legislative bodies has never been the only purpose of the census, it has always been the first and most important purpose. Indeed, this Constitutional requirement is a fundamental part of American democracy because it is the basis for equal representation. Not only are the figures used at the national level to apportion Congressional seats among the states, but states use them to set district boundaries for individual Congressional representatives and state legislatures. County and city officials also use the data to set election district boundaries for local representatives.

The use of census statistics in government programs has grown enormously. Today, in addition to the federal reve-

DUNAGIN'S PEOPLE



By Ralph Dunagin © Field Enterprises, Inc. 1979. Courtesy of Field Newspaper Syndicate.

"According to the Census Bureau, our state will gain two congressmen. . . . That's the price we pay for overpopulation."

As required by the Constitution, the decennial census provides the basis for fair reapportionment among the states of seats in the House of Representatives. It is also used to set district boundaries for state and local legislative bodies.

nue-sharing program, at least 100 other federal programs require the use of population estimates, based on the decennial census. They run the gamut from Agricultural Experiment Stations to Youth Recreational Services and even include a program for preventing hypertension. The use of population statistics derived from the census is also embedded in hundreds of state and federal laws which, while no money is attached, permit the locality to carry on certain functions, such as establish highway speed limits.

Probably the most extensive use of census statistics by all government agencies is for long-range planning. Public facilities such as highways, schools, water and sewer plants, and fire and police stations are not only expensive but are expected to be useful for at least 25 to 30 years. The need for these facilities now and in the future is usually determined by reference to past population trends and future projections from the most recent census.

But the fastest growing use of census statistics has been in the private sector.

There is hardly an American corporation that does not use census statistics in its product marketing, facilities planning, or personnel recruitment. Companies use the population characteristics to create new products for particular target groups. In the 1960s, the Ford Motor Company created the Mustang primarily for what was then a large and growing group of 18 to 24 year-olds, as revealed by the census.

The same type of information is useful when targeting advertising and promotion efforts. Pinpointing the location of the population group most likely to buy a product can avoid wasting advertising dollars. For example, advertising of products like tractor lawn mowers that appeal only to homeowners can be focused on cities and towns which have primarily owner-occupied dwelling units —information readily obtained from printed census reports. The same data can also be used to draw sales territories and set realistic sales goals.

In facilities planning, the determination that there are sufficient customers within the trading area of the store is usually done with the small area population and housing data available on census computer tapes. Prospective sites for an industrial plant can readily be evaluated using data on labor force characteristics from the census.

A new use of census summary data is for affirmative action. By reference to area labor force statistics by race and sex, it is possible to determine if there has been past discrimination at any facility. Court cases have been won on the basis of what census statistics showed.

Since there is no copyright on census data, they are repeated over and over in different publications by different authors until the original source is lost or forgotten. For example, the *Wall Street Journal* is often erroneously given credit for producing the unemployment statistics that appear periodically on its front page. They come from the Census Bureau's Current Population Survey, conducted monthly among a sample of some 50,000 households across the nation. Many people know how important demographic statistics are to every segment of our economy, but they may not know that the statistics come from the Census Bureau. The Bureau likes to tell the story of the person who wrote in 1970, "Why do we have to spend so much money to take the census? You could get all the figures from the World Almanac for free."

The 1980 Census Questionnaire

The 1980 questionnaire is similar to the one used in 1970 in that only a few basic questions are asked of every household and person. More information is asked of a sample of the population. The process is simpler for 1980, because only two forms of the questionnaire will be used—a short form for about 78 percent of the households and the long form for the remaining some 22 percent. In 1970 there were two versions of the long form, each given to a different sample of households.

For most areas of the country in 1980, a sample of one in every six households will receive the long form. In communities with populations below 2,500, the sampling will be on a one-in-two basis, in order to obtain more reliable statistics for revenue-sharing and other purposes.

The short questionnaire contains seven questions about population characteristics and 12 questions about housing. The long form contains these same questions plus an additional 20 housing and 26 population questions. The Census Bureau estimates that it takes about 15 minutes to complete the short questionnaire and 45 minutes for the long form.

During the planning for 1980, it was suggested that a question on income be added to the short questionnaire. Questions on income appeared only on the sample forms in 1970. In its early census tests, the Bureau found that such a question could be answered without difficulty. But several members of Congress, the press, and advisory groups suggested that such a sensitive question asked of every American would create undue burden and lower mail response rates for the short form. Because of this and other technical problems, the Bureau will be asking for income data only on a sample basis in 1980.

However, a question on Spanish origin or descent was moved from the sample questionnaire to a 100 percent basis in 1980, in part because Hispanic-Americans are becoming a larger proportion of the population.

Questions asked of everybody

Aside from the addition of the question on Spanish origin and a change in the wording of the household relationship item, the short form population questions remain basically the same as in 1970 with the exception of the question on race. This question has been modified and expanded for 1980. The specific reference to "color or race" has been replaced with the phrase, "Is this person—." The 1970 category "Negro or Black" has been reworded "Black or Negro." Separate categories for Vietnamese, Asian Indian, Guamanian, and Samoan have been added. The special questionnaire used for Alaska in 1970—in which the categories Hawaiian and Korean were replaced by Aleut and Eskimo—has been eliminated; now all four of those categories are on all questionnaires. As a result, the 1980 questionnaire will have 15 categories for this item instead of the nine used in 1970.

The 12 housing questions asked of all households in 1980 are significantly different from the 12 asked in 1970. The Census Bureau previously had asked for a telephone number where the respondent could be reached, and about kitchen facilities and a basement. For 1980, the kitchen facilities question and a telephone availability question have been moved to the sample questionnaire. The basement question did not yield sufficiently useful information in 1970 and was dropped. The request for a telephone number was used primarily for enumerator follow-up and has been moved to the back cover of the questionnaire for 1980. Previously there were three questions on the presence or absence of plumbing facilities; now there is only one. Also, newly worded questions attempt to elicit better information on the character and type of dwelling units. For example, there is now a separate question on condominiums, reflecting the large increase in that type of housing since 1970.

The questions about value, rent, and number of rooms in each dwelling are the same except that the impact of inflation shows up in the housing value and rents. In 1970, the highest house value asked was "$50,000 or more." In 1980, the highest value is "$200,000 or more."

"Head of household" eliminated

The census questionnaire mirrors changes in society. Just as the addition of a question on Spanish origin reflects the growing influence of Hispanics, the disappearance of the term "head of household" from the questionnaire reflects the growing influence of women in society. In 1980, each American household will be asked simply to indicate the relationship of other family members to the person who is listed in column one of the questionnaire. The respondent will choose which adult belongs in column one. In the past, the husband in married-couple families had been assumed to be the head. The new question on household relationship is worded as follows: "Start in this column with the household member (or one of the members) in whose name the home is owned or rented. If there is no such person, start in this column with any adult member."

This change is a significant one, perhaps the most significant change in the questionnaire from 1970. It was the product of considerable testing by the Census Bureau. A national survey of 940 households taken by the Bureau in September, 1975, interviewed husbands and wives separately about their preferences on the issue. Almost one-half of both husbands and wives said the husband was the head of the household; but fully one-third said the husband and wife were joint heads. Most of the remainder said the wife was the head.

Allowing the husband and wife to report as joint heads in questionnaire responses would create serious problems in identifying the household and family structure since the classifications of each household member must be made with regard to one reference person. There also would be problems in using household data because information such as age, education, employment status, occupation, and income of the household reference person or householder would be rendered meaningless if some husband-wife households contained joint heads while others reported individual heads. Also, tables showing family relationships would become impossible to create.

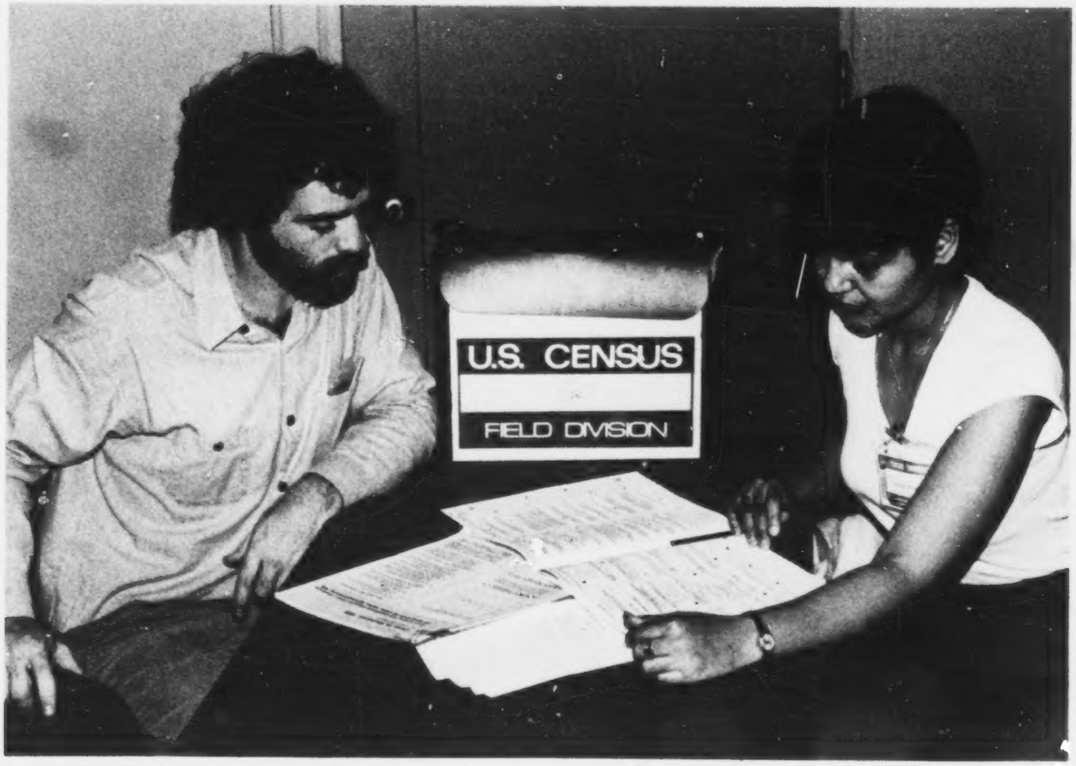
The Bureau's solution—to eliminate the term "head" entirely but to retain the concept of one family member as a point of reference, with individual families selecting that person—was tested successfully. Respondents had no more difficulty filling out the new form than with the old. Bureau officials do not believe that comparability with earlier data will be a problem; tabulations have been designed to facilitate comparison.

Questionnaire reproduced

Figure 2 (pages 18-23) presents a reproduction of the 1980 Census questionnaire with annotations pointing out changes from 1970 and other noteworthy details. The questionnaire was obtained from the Bureau of the Census; editing and annotations were done by the staff of *American Demographics* magazine and are reprinted here with permission.

This version of the questionnaire is given to a sample of the population. The first seven population questions are also asked of every American, and housing questions H1. through H12. are asked of every household. The rest of the questions are asked on a sample basis only.

The first question appears on the cover of both the short form (which has only the 100 percent questions) and the long form (the sample questionnaire). The question is: "What is the name of each person who was living here on Tuesday, April 1, 1980, or who was staying or visiting here and had no other home?" (Visitors with home addresses elsewhere are enumerated at that address.) Information from Question 1 is



used by the Census Bureau for follow-up if other questions are not answered. Names provided from this question are for Bureau follow-up purposes only and are not made public. As a standard procedure, a call will be made to every address that lists seven or more persons to be sure everyone has been counted. The questionnaire has spaces for only seven persons in each household.

The questionnaire begins with a pledge of confidentiality, Spanish-language instructions for those who wish to order a Spanish questionnaire, and the following message from the Census Bureau director:

"We must, from time-to-time, take stock of ourselves as a people if our Nation is to meet successfully the many national and local challenges we face. This is the purpose of the 1980 Census.

The essential need for a population census was recognized almost 200 years ago when our Constitution was written. As provided by article I, the first census was conducted in 1790 and one has been taken every 10 years since then.

The law under which the census is taken protects the confidentiality of your answers. For the next 72 years—or until April 1, 2052—only sworn census workers have access to the individual records, and no one else may see them.

Your answers, when combined with the answers from other people, will provide the statistical figures needed by public and private groups, schools, business and industry, and federal, state and local governments across the country. These figures will help all sectors of American society understand how our population and housing are changing. In this way, we can deal more effectively with today's problems and work toward a better future for all of us.

The census is a vitally important national activity. Please do your part by filling out this census form accurately and completely. If you mail it back promptly in the enclosed postage-paid envelope, it will save the expense and inconvenience of a census taker having to visit you.

Thank you for your cooperation."

Figure 2. The 1980 Questionnaire/Annotated

2. provides information on type of household (husband/wife, other type of family, or single person households) and the number of persons in the household. Because of changes in society since 1970, the concept of household "head" has been replaced with that of a reference person in whose name the dwelling unit is owned or rented. This person is identified in column one. This key change means data will not be exactly comparable to "male-headed" or "female-headed" household data from the 1970 Census, but it will be easy to identify families and other types of households. In many tabulations characteristics will be shown for both husband and wife where they were shown previously only for the head of family households.

The questionnaire has space for up to seven household members to provide answers. We show only column 1. The other columns are identical except for question 2, which asks relationship. In question 2, columns 2 through 7 have the following language instead of the "Start in this column" language: "If relative of person in column 1: Husband/wife; Son/daughter; Brother/sister; Father/mother; Other relative (specify). If not related to person in column 1: Roomer, boarder; Partner, roommate; Paid employee; Other nonrelative (specify)."

Two of the categories are new: "Partner, roommate" and "Paid employee." The first was added to obtain statistics on the growing number of people who live together without being married.

3. same as in 1970.

4. expands the possible answers about race from nine in 1970 to 15. As a result we can expect a few Samoans to turn up in places like Kansas City, just because that alternative is listed. The expansion is the result of growing ethnic awareness, but note that the word "race" does not appear.

5. same as in 1970.

6. same as in 1970.

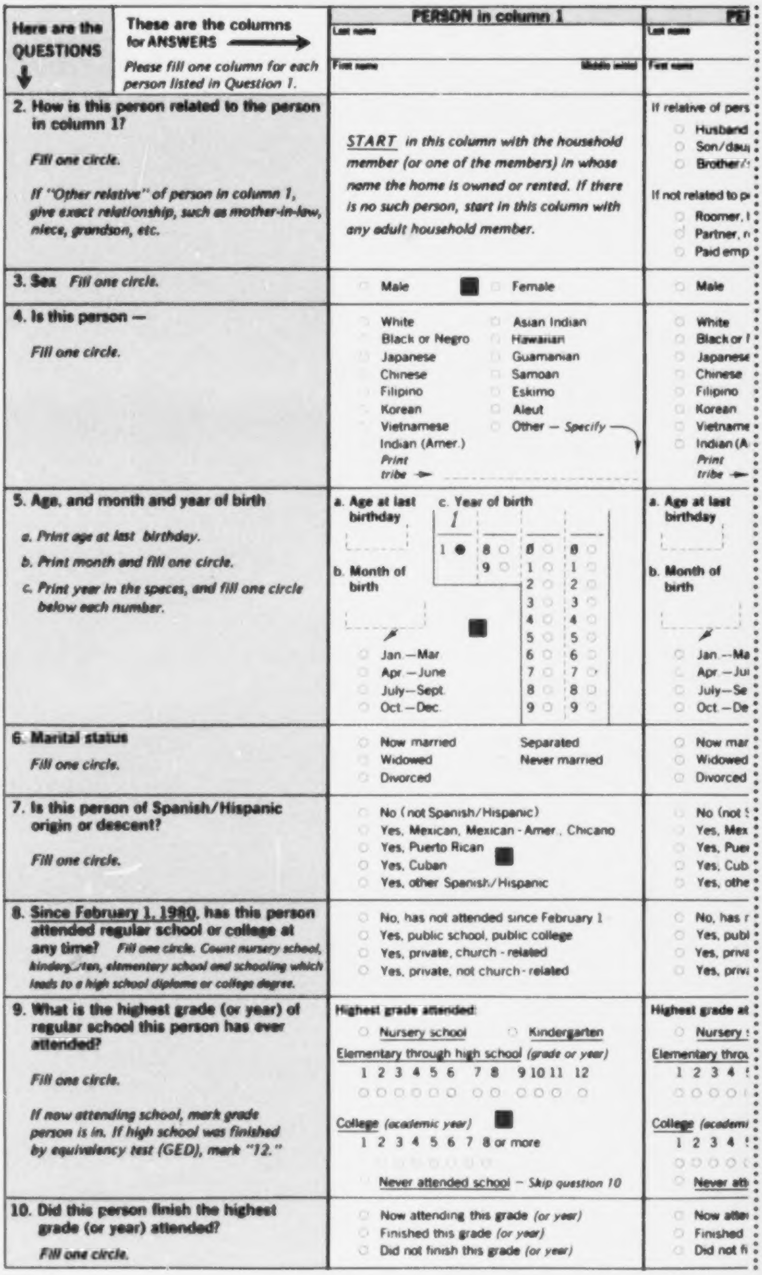
7. for the first time asks all Americans a single question about Spanish origin. These data will not be comparable with previous censuses. In 1970, this question was asked of a maximum of 15 percent of the population, and the data were tabulated differently for different regions of the country. This question ends the population questions asked of all Americans. The next three questions appear on the long form questionnaire only.

8. similar to 1970, but what was previously called "parochial" schools is now called "church related."

9. similar to 1970, but the highest college level asked for then was six or more years.

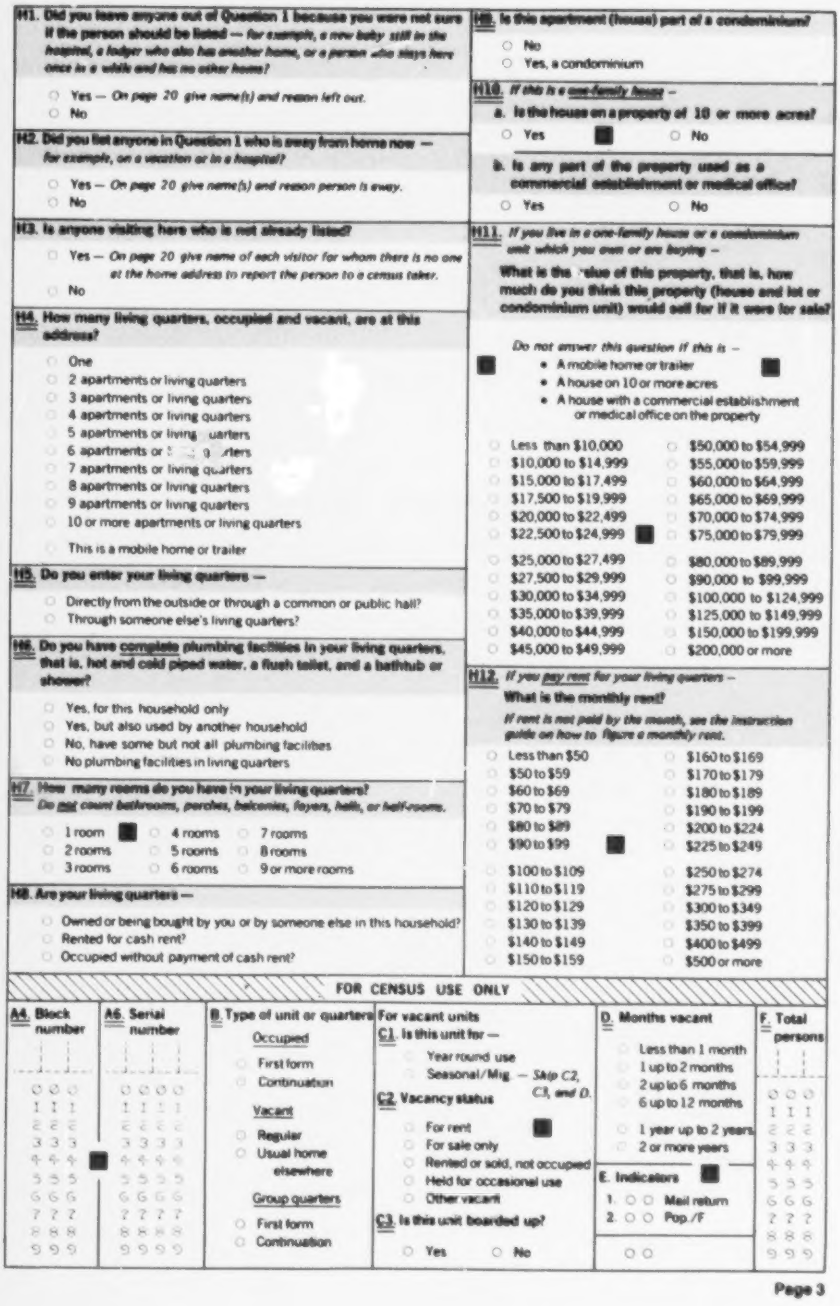
10. same as in 1970.

Note: Because of our format we have reduced the size of the questionnaire by about 40 percent and omitted certain instructions to respondents and Census Bureau use boxes. The census questionnaire also will have blue shading, not gray.



Here are the QUESTIONS ↓	These are the columns for ANSWERS ⟶ *Please fill one column for each person listed in Question 1.*	**PERSON in column 1** Last name First name Middle initial	PE Last name First name
2. How is this person related to the person in column 1? *Fill one circle.* *If "Other relative" of person in column 1, give exact relationship, such as mother-in-law, niece, grandson, etc.*		*START in this column with the household member (or one of the members) in whose name the home is owned or rented. If there is no such person, start in this column with any adult household member.*	If relative of pers ○ Husband ○ Son/dau ○ Brother/ If not related to p ○ Roomer, I ○ Partner, r ○ Paid emp
3. Sex *Fill one circle.*		○ Male ○ Female	○ Male
4. Is this person — *Fill one circle.*		○ White ○ Black or Negro ○ Japanese ○ Chinese ○ Filipino ○ Korean ○ Vietnamese ○ Indian (Amer.) *Print tribe* ⟵ ○ Asian Indian ○ Hawaiian ○ Guamanian ○ Samoan ○ Eskimo ○ Aleut ○ Other — *Specify*	○ White ○ Black or I ○ Japanese ○ Chinese ○ Filipino ○ Korean ○ Vietname ○ Indian (A *Print tribe* ⟵
5. Age, and month and year of birth *a. Print age at last birthday.* *b. Print month and fill one circle.* *c. Print year in the spaces, and fill one circle below each number.*		a. Age at last birthday b. Month of birth ○ Jan.—Mar. ○ Apr.—June ○ July—Sept. ○ Oct.—Dec. c. Year of birth 1 ● 8 ○ 9 ○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○	a. Age at last birthday b. Month of birth ○ Jan.—Ma ○ Apr.—Ju ○ July—Se ○ Oct.—De
6. Marital status *Fill one circle.*		○ Now married ○ Widowed ○ Divorced ○ Separated ○ Never married	○ Now mar ○ Widowed ○ Divorced
7. Is this person of Spanish/Hispanic origin or descent? *Fill one circle.*		○ No (not Spanish/Hispanic) ○ Yes, Mexican, Mexican-Amer., Chicano ○ Yes, Puerto Rican ○ Yes, Cuban ○ Yes, other Spanish/Hispanic	○ No (not S ○ Yes, Mex ○ Yes, Puer ○ Yes, Cub ○ Yes, othe
8. Since February 1, 1980, has this person attended regular school or college at any time? *Fill one circle. Count nursery school, kindergarten, elementary school and schooling which leads to a high school diploma or college degree.*		○ No, has not attended since February 1 ○ Yes, public school, public college ○ Yes, private, church-related ○ Yes, private, not church-related	○ No, has r ○ Yes, publ ○ Yes, priva ○ Yes, priva
9. What is the highest grade (or year) of regular school this person has ever attended? *Fill one circle.* *If now attending school, mark grade person is in. If high school was finished by equivalency test (GED), mark "12."*		Highest grade attended: ○ Nursery school ○ Kindergarten Elementary through high school *(grade or year)* 1 2 3 4 5 6 7 8 9 10 11 12 ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ College *(academic year)* 1 2 3 4 5 6 7 8 or more ○ ○ ○ ○ ○ ○ ○ ○ ○ Never attended school — *Skip question 10*	Highest grade at ○ Nursery Elementary throu 1 2 3 4 ○ ○ ○ ○ College *(academi* 1 2 3 4 ○ ○ ○ ○ ○ Never att
10. Did this person finish the highest grade (or year) attended? *Fill one circle.*		○ Now attending this grade *(or year)* ○ Finished this grade *(or year)* ○ Did not finish this grade *(or year)*	○ Now atte ○ Finished ○ Did not fi

Page 2



H1. Did you leave anyone out of Question 1 because you were not sure if the person should be listed — *for example, a new baby still in the hospital, a lodger who also has another home, or a person who stays here once in a while and has no other home?*

○ Yes — *On page 20 give name(s) and reason left out.*
○ No

H2. Did you list anyone in Question 1 who is away from home now — *for example, on a vacation or in a hospital?*

○ Yes — *On page 20 give name(s) and reason person is away.*
○ No

H3. Is anyone visiting here who is not already listed?

○ Yes — *On page 20 give name of each visitor for whom there is no one at the home address to report the person to a census taker.*
○ No

H4. How many living quarters, occupied and vacant, are at this address?

○ One
○ 2 apartments or living quarters
○ 3 apartments or living quarters
○ 4 apartments or living quarters
○ 5 apartments or living quarters
○ 6 apartments or [illegible]rters
○ 7 apartments or living quarters
○ 8 apartments or living quarters
○ 9 apartments or living quarters
○ 10 or more apartments or living quarters

○ This is a mobile home or trailer

H5. Do you enter your living quarters —

○ Directly from the outside or through a common or public hall?
○ Through someone else's living quarters?

H6. Do you have complete plumbing facilities in your living quarters, that is, hot and cold piped water, a flush toilet, and a bathtub or shower?

○ Yes, for this household only
○ Yes, but also used by another household
○ No, have some but not all plumbing facilities
○ No plumbing facilities in living quarters

H7. How many rooms do you have in your living quarters?
Do not count bathrooms, porches, balconies, foyers, halls, or half-rooms.

○ 1 room	○ 4 rooms	○ 7 rooms
○ 2 rooms	○ 5 rooms	○ 8 rooms
○ 3 rooms	○ 6 rooms	○ 9 or more rooms

H8. Are your living quarters —

○ Owned or being bought by you or by someone else in this household?
○ Rented for cash rent?
○ Occupied without payment of cash rent?

H9. Is this apartment (house) part of a condominium?

○ No
○ Yes, a condominium

H10. *If this is a one-family house —*

a. Is the house on a property of 10 or more acres?

○ Yes ○ No

b. Is any part of the property used as a commercial establishment or medical office?

○ Yes ○ No

H11. *If you live in a one-family house or a condominium unit which you own or are buying —*

What is the value of this property, that is, how much do you think this property (house and lot or condominium unit) would sell for if it were for sale?

Do not answer this question if this is —

- A mobile home or trailer
- A house on 10 or more acres
- A house with a commercial establishment or medical office on the property

○ Less than $10,000	○ $50,000 to $54,999
○ $10,000 to $14,999	○ $55,000 to $59,999
○ $15,000 to $17,499	○ $60,000 to $64,999
○ $17,500 to $19,999	○ $65,000 to $69,999
○ $20,000 to $22,499	○ $70,000 to $74,999
○ $22,500 to $24,999	○ $75,000 to $79,999
○ $25,000 to $27,499	○ $80,000 to $89,999
○ $27,500 to $29,999	○ $90,000 to $99,999
○ $30,000 to $34,999	○ $100,000 to $124,999
○ $35,000 to $39,999	○ $125,000 to $149,999
○ $40,000 to $44,999	○ $150,000 to $199,999
○ $45,000 to $49,999	○ $200,000 or more

H12. *If you pay rent for your living quarters —*

What is the monthly rent?

If rent is not paid by the month, see the instruction guide on how to figure a monthly rent.

○ Less than $50	○ $160 to $169
○ $50 to $59	○ $170 to $179
○ $60 to $69	○ $180 to $189
○ $70 to $79	○ $190 to $199
○ $80 to $89	○ $200 to $224
○ $90 to $99	○ $225 to $249
○ $100 to $109	○ $250 to $274
○ $110 to $119	○ $275 to $299
○ $120 to $129	○ $300 to $349
○ $130 to $139	○ $350 to $399
○ $140 to $149	○ $400 to $499
○ $150 to $159	○ $500 or more

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A4. Block number

0 0 0
1 1 1
2 2 2
3 3 3
4 4 4
5 5 5
6 6 6
7 7 7
8 8 8
9 9 9

A6. Serial number

0 0 0 0
1 1 1 1
2 2 2 2
3 3 3 3
4 4 4 4
5 5 5 5
6 6 6 6
7 7 7 7
8 8 8 8
9 9 9 9

B. Type of unit or quarters

Occupied
○ First form
○ Continuation

Vacant
○ Regular
○ Usual home elsewhere

Group quarters
○ First form
○ Continuation

For vacant units

C1. Is this unit for —

○ Year round use
○ Seasonal/Mig. — *Skip C2, C3, and D.*

C2. Vacancy status

○ For rent
○ For sale only
○ Rented or sold, not occupied
○ Held for occasional use
○ Other vacant

C3. Is this unit boarded up?

○ Yes ○ No

D. Months vacant

○ Less than 1 month
○ 1 up to 2 months
○ 2 up to 6 months
○ 6 up to 12 months

○ 1 year up to 2 years
○ 2 or more years

E. Indicators

1. ○ ○ Mail return
2. ○ ○ Pop./F

○ ○

F. Total persons

0 0 0
1 1 1
2 2 2
3 3 3
4 4 4
5 5 5
6 6 6
7 7 7
8 8 8
9 9 9

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H1-H3. the housing part of both the 100 percent and sample questionnaires starts with these three questions to make sure that everyone in the household was counted.

H4. same as in 1970. This question is asked so that census personnel can be sure that all units at an address are enumerated. Question H13 provides superior data on the number of dwelling units in the structure. Like the first three housing questions, H4 is intended to check coverage.

H5. has the objective of making certain the respondent occupies a bona fide dwelling unit, not just a few rooms in someone else's house.

H6. one of the few questions left from a series of questions in the 1970 Census which attempted to measure housing quality.

H7. same as in 1970.

H8. same as in 1970.

H9. for the first time poses a separate question on condominiums. The term "cooperative" also appeared on the test questionnaires but was misunderstood by many respondents.

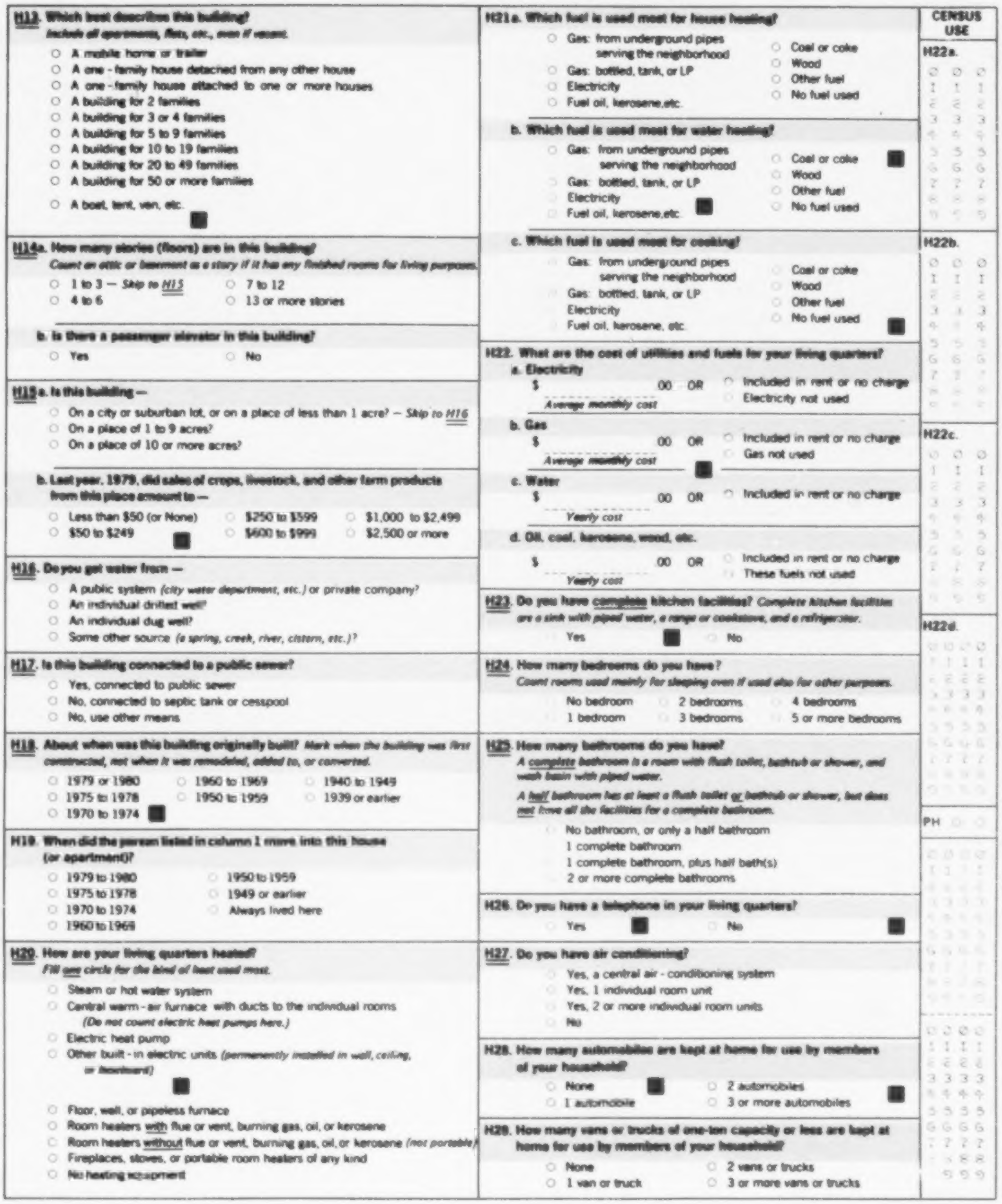
H10. separates farmhouses, estates, and partly commercial structures from single family dwelling units. Value is not tabulated for these types of units.

H11. asks value. There are 24 categories instead of the 11 in 1970, when the highest value was only $50,000 or more.

H12. also shows the impact of inflation. The highest interval in 1970 was $300 or more. It is now $500 or more, and 24 categories appear instead of the former 14.

H12 ends the housing questions asked of all Americans. The Census Bureau estimates it takes 15 minutes to answer the 19 population and housing questions on the short questionnaire, while the remaining questions add another 30 minutes.

Figure 2. The 1980 Census Questionnaire/Annotated (cont.)



H13. Which best describes this building?
Include all apartments, flats, etc., even if vacant.
- ○ A mobile home or trailer
- ○ A one-family house detached from any other house
- ○ A one-family house attached to one or more houses
- ○ A building for 2 families
- ○ A building for 3 or 4 families
- ○ A building for 5 to 9 families
- ○ A building for 10 to 19 families
- ○ A building for 20 to 49 families
- ○ A building for 50 or more families
- ○ A boat, tent, van, etc.

H14a. How many stories (floors) are in this building?
Count an attic or basement as a story if it has any finished rooms for living purposes.
- ○ 1 to 3 — *Skip to H15*
- ○ 4 to 6
- ○ 7 to 12
- ○ 13 or more stories

b. Is there a passenger elevator in this building?
- ○ Yes
- ○ No

H15a. Is this building —
- ○ On a city or suburban lot, or on a place of less than 1 acre? — *Skip to H16*
- ○ On a place of 1 to 9 acres?
- ○ On a place of 10 or more acres?

b. Last year, 1979, did sales of crops, livestock, and other farm products from this place amount to —
- ○ Less than $50 (or None)
- ○ $50 to $249
- ○ $250 to $599
- ○ $600 to $999
- ○ $1,000 to $2,499
- ○ $2,500 or more

H16. Do you get water from —
- ○ A public system *(city water department, etc.)* or private company?
- ○ An individual drilled well?
- ○ An individual dug well?
- ○ Some other source *(a spring, creek, river, cistern, etc.)*?

H17. Is this building connected to a public sewer?
- ○ Yes, connected to public sewer
- ○ No, connected to septic tank or cesspool
- ○ No, use other means

H18. About when was this building originally built? *Mark when the building was first constructed, not when it was remodeled, added to, or converted.*
- ○ 1979 or 1980
- ○ 1975 to 1978
- ○ 1970 to 1974
- ○ 1960 to 1969
- ○ 1950 to 1959
- ○ 1940 to 1949
- ○ 1939 or earlier

H19. When did the person listed in column 1 move into this house (or apartment)?
- ○ 1979 to 1980
- ○ 1975 to 1978
- ○ 1970 to 1974
- ○ 1960 to 1969
- ○ 1950 to 1959
- ○ 1949 or earlier
- ○ Always lived here

H20. How are your living quarters heated?
Fill one circle for the kind of heat used most.
- ○ Steam or hot water system
- ○ Central warm-air furnace with ducts to the individual rooms *(Do not count electric heat pumps here.)*
- ○ Electric heat pump
- ○ Other built-in electric units *(permanently installed in wall, ceiling, or baseboard)*
- ○ Floor, wall, or pipeless furnace
- ○ Room heaters with flue or vent, burning gas, oil, or kerosene
- ○ Room heaters without flue or vent, burning gas, oil, or kerosene *(not portable)*
- ○ Fireplaces, stoves, or portable room heaters of any kind
- ○ No heating equipment

H21a. Which fuel is used most for house heating?
- ○ Gas: from underground pipes serving the neighborhood
- ○ Gas: bottled, tank, or LP
- ○ Electricity
- ○ Fuel oil, kerosene, etc.
- ○ Coal or coke
- ○ Wood
- ○ Other fuel
- ○ No fuel used

b. Which fuel is used most for water heating?
- ○ Gas: from underground pipes serving the neighborhood
- ○ Gas: bottled, tank, or LP
- ○ Electricity
- ○ Fuel oil, kerosene, etc.
- ○ Coal or coke
- ○ Wood
- ○ Other fuel
- ○ No fuel used

c. Which fuel is used most for cooking?
- ○ Gas: from underground pipes serving the neighborhood
- ○ Gas: bottled, tank, or LP
- ○ Electricity
- ○ Fuel oil, kerosene, etc.
- ○ Coal or coke
- ○ Wood
- ○ Other fuel
- ○ No fuel used

H22. What are the cost of utilities and fuels for your living quarters?

a. Electricity
$ ______ .00 OR ○ Included in rent or no charge ○ Electricity not used
Average monthly cost

b. Gas
$ ______ .00 OR ○ Included in rent or no charge ○ Gas not used
Average monthly cost

c. Water
$ ______ .00 OR ○ Included in rent or no charge
Yearly cost

d. Oil, coal, kerosene, wood, etc.
$ ______ .00 OR ○ Included in rent or no charge ○ These fuels not used
Yearly cost

H23. Do you have complete kitchen facilities? *Complete kitchen facilities are a sink with piped water, a range or cookstove, and a refrigerator.*
- ○ Yes
- ○ No

H24. How many bedrooms do you have?
Count rooms used mainly for sleeping even if used also for other purposes.
- ○ No bedroom
- ○ 1 bedroom
- ○ 2 bedrooms
- ○ 3 bedrooms
- ○ 4 bedrooms
- ○ 5 or more bedrooms

H25. How many bathrooms do you have?
A complete bathroom is a room with flush toilet, bathtub or shower, and wash basin with piped water.
A half bathroom has at least a flush toilet or bathtub or shower, but does not have all the facilities for a complete bathroom.
- ○ No bathroom, or only a half bathroom
- ○ 1 complete bathroom
- ○ 1 complete bathroom, plus half bath(s)
- ○ 2 or more complete bathrooms

H26. Do you have a telephone in your living quarters?
- ○ Yes
- ○ No

H27. Do you have air conditioning?
- ○ Yes, a central air-conditioning system
- ○ Yes, 1 individual room unit
- ○ Yes, 2 or more individual room units
- ○ No

H28. How many automobiles are kept at home for use by members of your household?
- ○ None
- ○ 1 automobile
- ○ 2 automobiles
- ○ 3 or more automobiles

H29. How many vans or trucks of one-ton capacity or less are kept at home for use by members of your household?
- ○ None
- ○ 1 van or truck
- ○ 2 vans or trucks
- ○ 3 or more vans or trucks

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H22a.
H22b.
H22c.
H22d.
PH

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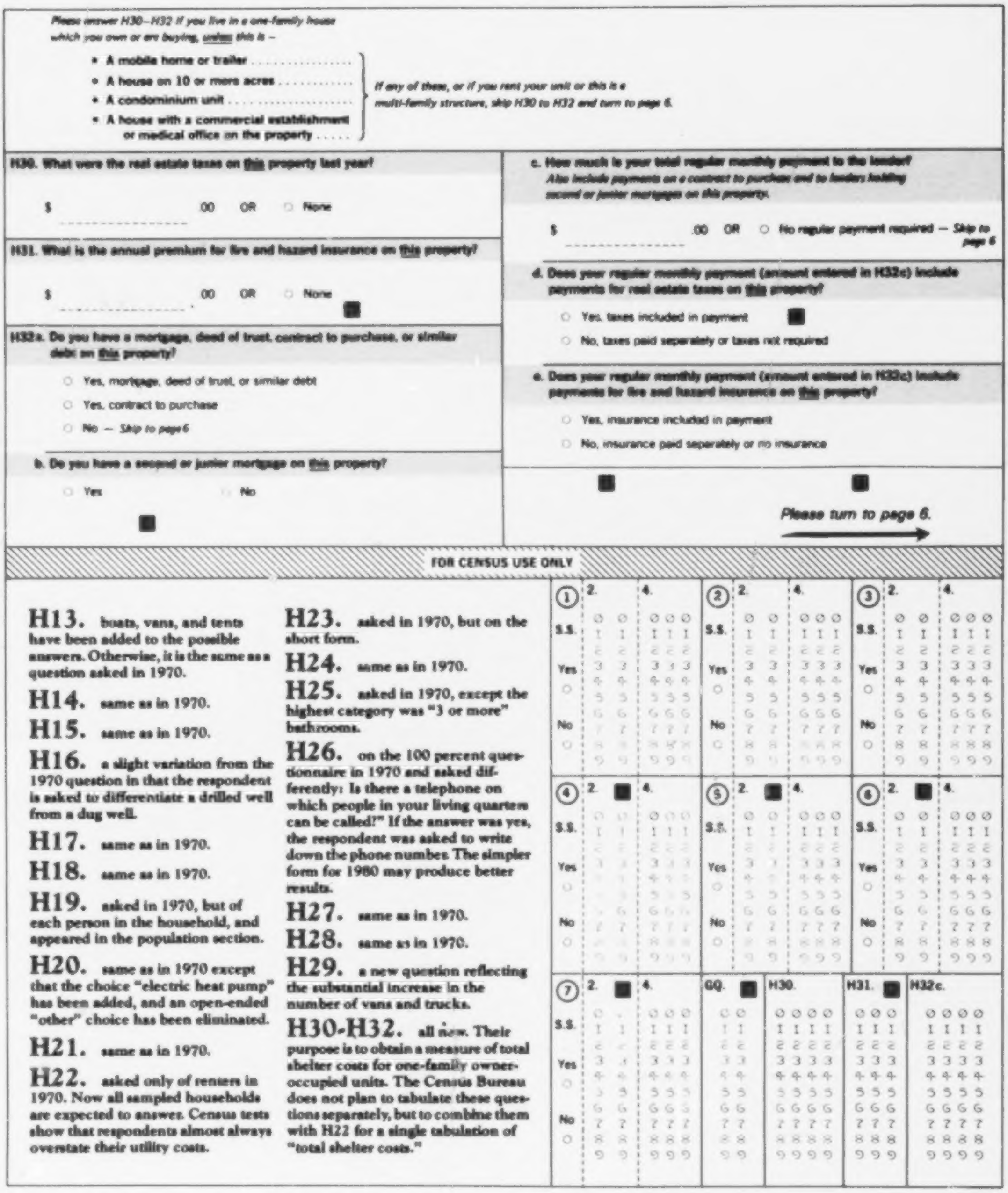

Please answer H30–H32 if you live in a one-family house which you own or are buying, unless this is –

- A mobile home or trailer . . . .
- A house on 10 or more acres . . . .
- A condominium unit . . . .
- A house with a commercial establishment or medical office on the property . . . . .

If any of these, or if you rent your unit or this is a multi-family structure, skip H30 to H32 and turn to page 6.

H30. What were the real estate taxes on this property last year?

$ ________________ .00 OR ☐ None

H31. What is the annual premium for fire and hazard insurance on this property?

$ ________________ .00 OR ☐ None

H32a. Do you have a mortgage, deed of trust, contract to purchase, or similar debt on this property?

○ Yes, mortgage, deed of trust, or similar debt

○ Yes, contract to purchase

○ No — *Skip to page 6*

b. Do you have a second or junior mortgage on this property?

○ Yes ○ No

c. How much is your total regular monthly payment to the lender?
Also include payments on a contract to purchase and to lenders holding second or junior mortgages on this property.

$ ________________ .00 OR ○ No regular payment required — *Skip to page 6*

d. Does your regular monthly payment (amount entered in H32c) include payments for real estate taxes on this property?

○ Yes, taxes included in payment

○ No, taxes paid seperately or taxes not required

e. Does your regular monthly payment (amount entered in H32c) include payments for fire and hazard insurance on this property?

○ Yes, insurance included in payment

○ No, insurance paid seperately or no insurance

Please turn to page 6. →

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H13. boats, vans, and tents have been added to the possible answers. Otherwise, it is the same as a question asked in 1970.

H14. same as in 1970.

H15. same as in 1970.

H16. a slight variation from the 1970 question in that the respondent is asked to differentiate a drilled well from a dug well.

H17. same as in 1970.

H18. same as in 1970.

H19. asked in 1970, but of each person in the household, and appeared in the population section.

H20. same as in 1970 except that the choice "electric heat pump" has been added, and an open-ended "other" choice has been eliminated.

H21. same as in 1970.

H22. asked only of renters in 1970. Now all sampled households are expected to answer. Census tests show that respondents almost always overstate their utility costs.

H23. asked in 1970, but on the short form.

H24. same as in 1970.

H25. asked in 1970, except the highest category was "3 or more" bathrooms.

H26. on the 100 percent questionnaire in 1970 and asked differently: Is there a telephone on which people in your living quarters can be called?" If the answer was yes, the respondent was asked to write down the phone number. The simpler form for 1980 may produce better results.

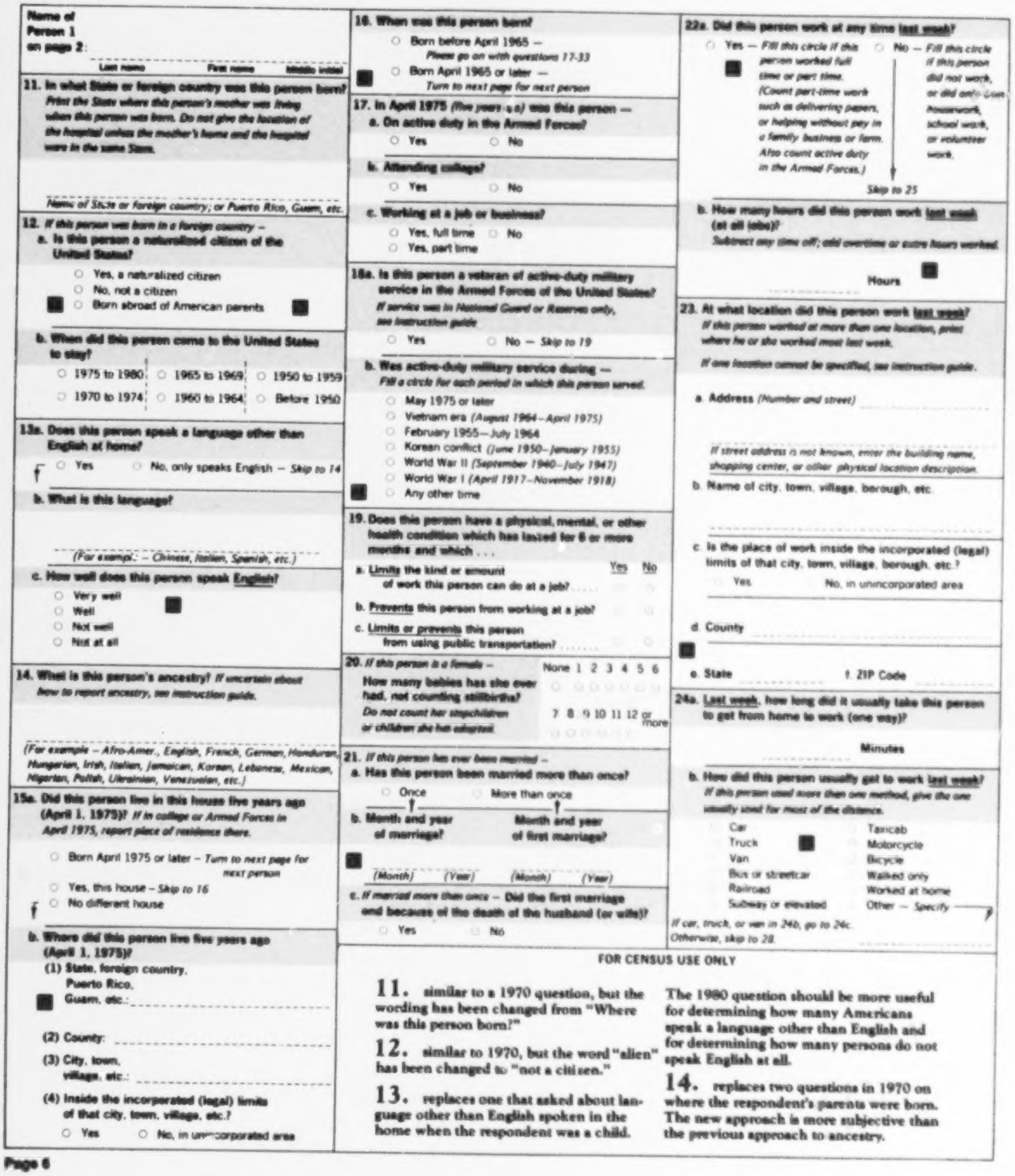
H27. same as in 1970.

H28. same as in 1970.

H29. a new question reflecting the substantial increase in the number of vans and trucks.

H30-H32. all new. Their purpose is to obtain a measure of total shelter costs for one-family owner-occupied units. The Census Bureau does not plan to tabulate these questions separately, but to combine them with H22 for a single tabulation of "total shelter costs."

Figure 2. The 1980 Census Questionnaire/Annotated (cont.)



Name of Person 1 on page 2:
Last name — First name — Middle initial

11. In what State or foreign country was this person born? *Print the State where this person's mother was living when this person was born. Do not give the location of the hospital unless the mother's home and the hospital were in the same State.*

Name of State or foreign country; or Puerto Rico, Guam, etc.

12. *If this person was born in a foreign country –*
a. Is this person a naturalized citizen of the United States?
○ Yes, a naturalized citizen
○ No, not a citizen
○ Born abroad of American parents

b. When did this person come to the United States to stay?
○ 1975 to 1980 ○ 1965 to 1969 ○ 1950 to 1959
○ 1970 to 1974 ○ 1960 to 1964 ○ Before 1950

13a. Does this person speak a language other than English at home?
○ Yes ○ No, only speaks English – *Skip to 14*

b. What is this language?
(For example: – Chinese, Italian, Spanish, etc.)

c. How well does this person speak English?
○ Very well
○ Well
○ Not well
○ Not at all

14. What is this person's ancestry? *If uncertain about how to report ancestry, see instruction guide.*
(For example – Afro-Amer., English, French, German, Honduran, Hungarian, Irish, Italian, Jamaican, Korean, Lebanese, Mexican, Nigerian, Polish, Ukrainian, Venezuelan, etc.)

15a. Did this person live in this house five years ago (April 1, 1975)? *If in college or Armed Forces in April 1975, report place of residence there.*
○ Born April 1975 or later – *Turn to next page for next person*
○ Yes, this house – *Skip to 16*
○ No different house

b. Where did this person live five years ago (April 1, 1975)?
(1) State, foreign country, Puerto Rico, Guam, etc.:
(2) County:
(3) City, town, village, etc.:
(4) Inside the incorporated (legal) limits of that city, town, village, etc.?
○ Yes ○ No, in unincorporated area

16. When was this person born?
○ Born before April 1965 – *Please go on with questions 17-33*
○ Born April 1965 or later – *Turn to next page for next person*

17. In April 1975 *(five years ago)* **was this person –**
a. On active duty in the Armed Forces?
○ Yes ○ No
b. Attending college?
○ Yes ○ No
c. Working at a job or business?
○ Yes, full time ○ No
○ Yes, part time

18a. Is this person a veteran of active-duty military service in the Armed Forces of the United States? *If service was in National Guard or Reserves only, see instruction guide.*
○ Yes ○ No – *Skip to 19*

b. Was active-duty military service during – *Fill a circle for each period in which this person served.*
○ May 1975 or later
○ Vietnam era *(August 1964–April 1975)*
○ February 1955–July 1964
○ Korean conflict *(June 1950–January 1955)*
○ World War II *(September 1940–July 1947)*
○ World War I *(April 1917–November 1918)*
○ Any other time

19. Does this person have a physical, mental, or other health condition which has lasted for 6 or more months and which . . .

	Yes	No
a. Limits the kind or amount of work this person can do at a job?	○	○
b. Prevents this person from working at a job?	○	○
c. Limits or prevents this person from using public transportation?	○	○

20. *If this person is a female –*
How many babies has she ever had, not counting stillbirths? *Do not count her stepchildren or children she has adopted.*
None 1 2 3 4 5 6 7 8 9 10 11 12 or more

21. *If this person has ever been married –*
a. Has this person been married more than once?
○ Once ○ More than once
b. Month and year of marriage? **Month and year of first marriage?**
(Month) (Year) (Month) (Year)
c. *If married more than once –* **Did the first marriage end because of the death of the husband (or wife)?**
○ Yes ○ No

22a. Did this person work at any time last week?
○ Yes – *Fill this circle if this person worked full time or part time. (Count part-time work such as delivering papers, or helping without pay in a family business or farm. Also count active duty in the Armed Forces.)*
○ No – *Fill this circle if this person did not work, or did only own housework, school work, or volunteer work.* *Skip to 25*

b. How many hours did this person work last week (at all jobs)? *Subtract any time off; add overtime or extra hours worked.*
Hours

23. At what location did this person work last week? *If this person worked at more than one location, print where he or she worked most last week.*
If one location cannot be specified, see instruction guide.
a. Address *(Number and street)*
If street address is not known, enter the building name, shopping center, or other physical location description.
b. Name of city, town, village, borough, etc.
c. Is the place of work inside the incorporated (legal) limits of that city, town, village, borough, etc.?
○ Yes ○ No, in unincorporated area
d. County
e. State **f. ZIP Code**

24a. Last week, how long did it usually take this person to get from home to work (one way)?
Minutes

b. How did this person usually get to work last week? *If this person used more than one method, give the one usually used for most of the distance.*
○ Car ○ Taxicab
○ Truck ○ Motorcycle
○ Van ○ Bicycle
○ Bus or streetcar ○ Walked only
○ Railroad ○ Worked at home
○ Subway or elevated ○ Other – *Specify*
If car, truck, or van in 24b, go to 24c. Otherwise, skip to 28.

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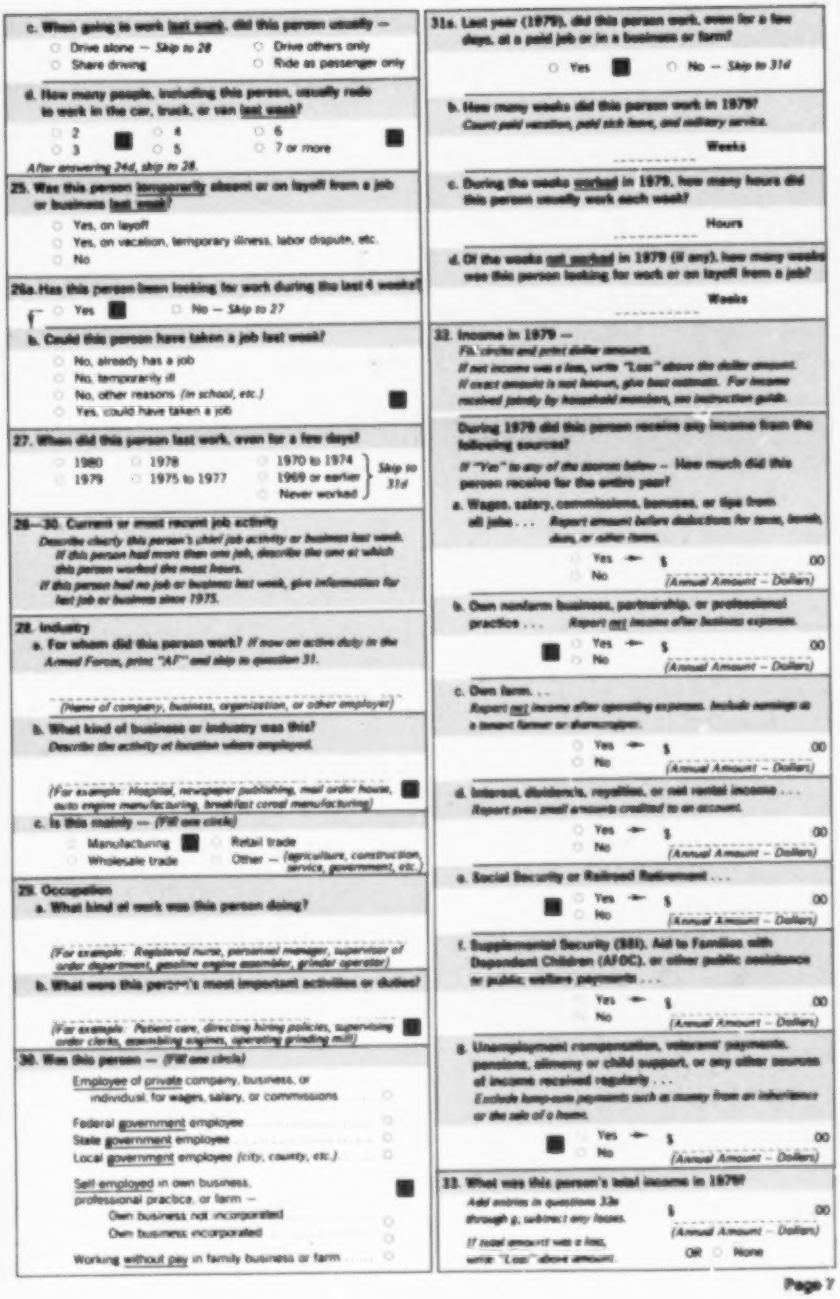
11. similar to a 1970 question, but the wording has been changed from "Where was this person born?"

12. similar to 1970, but the word "alien" has been changed to "not a citizen."

13. replaces one that asked about language other than English spoken in the home when the respondent was a child. The 1980 question should be more useful for determining how many Americans speak a language other than English and for determining how many persons do not speak English at all.

14. replaces two questions in 1970 on where the respondent's parents were born. The new approach is more subjective than the previous approach to ancestry.



c. When going to work last week, did this person usually —

○ Drive alone — *Skip to 28*
○ Share driving
○ Drive others only
○ Ride as passenger only

d. How many people, including this person, usually rode to work in the car, truck, or van last week?

○ 2
○ 3
○ 4
○ 5
○ 6
○ 7 or more

After answering 24d, skip to 28.

25. Was this person temporarily absent or on layoff from a job or business last week?

○ Yes, on layoff
○ Yes, on vacation, temporary illness, labor dispute, etc.
○ No

26a. Has this person been looking for work during the last 4 weeks?

○ Yes
○ No — *Skip to 27*

b. Could this person have taken a job last week?

○ No, already has a job
○ No, temporarily ill
○ No, other reasons *(in school, etc.)*
○ Yes, could have taken a job

27. When did this person last work, even for a few days?

○ 1980
○ 1979
○ 1978
○ 1975 to 1977
○ 1970 to 1974
○ 1969 or earlier
○ Never worked
} *Skip to 31d*

28—30. Current or most recent job activity

Describe clearly this person's chief job activity or business last week. If this person had more than one job, describe the one at which this person worked the most hours.
If this person had no job or business last week, give information for last job or business since 1975.

28. Industry

a. For whom did this person work? *If now on active duty in the Armed Forces, print "AF" and skip to question 31.*

(Name of company, business, organization, or other employer)

b. What kind of business or industry was this?
Describe the activity at location where employed.

(For example: Hospital, newspaper publishing, mail order house, auto engine manufacturing, breakfast cereal manufacturing)

c. Is this mainly — *(Fill one circle)*

○ Manufacturing
○ Wholesale trade
○ Retail trade
○ Other — *(agriculture, construction, service, government, etc.)*

29. Occupation

a. What kind of work was this person doing?

(For example: Registered nurse, personnel manager, supervisor of order department, gasoline engine assembler, grinder operator)

b. What were this person's most important activities or duties?

(For example: Patient care, directing hiring policies, supervising order clerks, assembling engines, operating grinding mill)

30. Was this person — *(Fill one circle)*

Employee of private company, business, or individual, for wages, salary, or commissions ○

Federal government employee ○
State government employee ○
Local government employee *(city, county, etc.)* ○

Self-employed in own business, professional practice, or farm —
Own business not incorporated ○
Own business incorporated ○

Working without pay in family business or farm ○

31a. Last year (1979), did this person work, even for a few days, at a paid job or in a business or farm?

○ Yes
○ No — *Skip to 31d*

b. How many weeks did this person work in 1979?
Count paid vacation, paid sick leave, and military service.

Weeks

c. During the weeks worked in 1979, how many hours did this person usually work each week?

Hours

d. Of the weeks not worked in 1979 (if any), how many weeks was this person looking for work or on layoff from a job?

Weeks

32. Income in 1979 —
Fill circles and print dollar amounts.
If net income was a loss, write "Loss" above the dollar amount.
If exact amount is not known, give best estimate. For income received jointly by household members, see instruction guide.

During 1979 did this person receive any income from the following sources?

If "Yes" to any of the sources below — How much did this person receive for the entire year?

a. Wages, salary, commissions, bonuses, or tips from all jobs . . . *Report amount before deductions for taxes, bonds, dues, or other items.*

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

b. Own nonfarm business, partnership, or professional practice . . . *Report net income after business expenses.*

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

c. Own farm . . .
Report net income after operating expenses. Include earnings as a tenant farmer or sharecropper.

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

d. Interest, dividends, royalties, or net rental income . . .
Report even small amounts credited to an account.

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

e. Social Security or Railroad Retirement . . .

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

f. Supplemental Security (SSI), Aid to Families with Dependent Children (AFDC), or other public assistance or public welfare payments . . .

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

g. Unemployment compensation, veterans' payments, pensions, alimony or child support, or any other sources of income received regularly . . .
Exclude lump-sum payments such as money from an inheritance or the sale of a home.

○ Yes → $ 00
○ No *(Annual Amount – Dollars)*

33. What was this person's total income in 1979?

Add entries in questions 32a through g; subtract any losses.

If total amount was a loss, write "Loss" above amount.

$ 00
(Annual Amount – Dollars)
OR ○ None

Page 7

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15. same as in 1970.

16. same as in 1970.

17. same as in 1970.

18. same as in 1970.

19. resembles a question asked in 1970, but then it was asked only of persons less than 65 years old and was concerned only with a work disability. The 1980 question tested poorly, but so many public agencies need disability data that the question will appear anyway.

20. same as in 1970.

21. same as in 1970.

22. asked in 1970, but in 1980 respondents are also asked to write in the number of hours worked.

23. same as in 1970.

24a. a new question which attempts to measure average time spent getting to work.

24b. same as in 1970 but with the additional categories of truck, van, motorcycle, or bicycle.

24c & d. a new series of questions to measure the extent of carpooling.

25. same as in 1970.

26. same as in 1970.

27. same as in 1970.

28. resembles a question asked in 1970, but the words "... this person" have been substituted for the pronoun "he" in the questions on occupation, industry, and income.

29. same as in 1970.

30. same as in 1970.

31a & b. same as in 1970.

31c & d. new questions to measure part-time workers and the extent of unemployment in the previous year.

32. similar to 1970 except that the question has been recast as "income" instead of "earnings" and "interest, dividends ..." and "unemployment compensation ..." have been separated.

33. appeared in 1970 in slightly different form as part of the earnings question. This is the last question. The questions about population characteristics are repeated for up to seven persons in the household. If there are more than seven persons in a household an enumerator calls and tabulates responses of the additional persons.

Census Products and Services

Were the Census Bureau to print on paper all of the possible data tabulations from the 1980 Census, it would probably be the end of every tree on earth. Fortunately, only a tiny fraction of the data obtained from the census is available in paper form.

Nevertheless, the amount is enormous and has doubled with every recent census. In 1950, approximately 50,000 pages were printed, in 1960 there were 100,000 pages, and in 1970, 200,000 pages. Trying to slow this geometric growth, the Census Bureau plans to print only about 250,000 pages of reports for the 1980 Census.

The printed reports will be published in three major series—"preliminary," "advance," and "final." The preliminary reports, printed in the early fall of 1980, will show only the unofficial population and housing counts as compiled in the census field offices. Those reports will be superseded in the spring of 1981 by the advance reports containing official population and housing counts for all political subdivisions such as counties, towns, cities, and villages.

During 1981 and 1982, the final population and housing characteristics reports will be published. The less detailed reports will be available first, and the most detailed later in 1982. Preliminary and advance reports are sold by the Subscribers Services Section (Bureau of the Census, Washington, D.C. 20233), but the final reports are sold by the Superintendent of Documents (U.S. Government Printing Office, Washington, D.C. 20402). All publications and data files of the Census Bureau are listed in the agency's annual catalog, which has quarterly and monthly supplements. Order forms for any Bureau publications may be obtained without charge from the Subscribers Services Section. Appendix A (pages 34-35) gives titles of the various series and approximate dates when they will be available. Figure 3 illustrates how data are presented in printed reports and on computer tape.

Printed census publications can be found in the 117 libraries around the country designated as census depository libraries and sometimes in the more than 1,000 other government depository libraries. In addition, all Bureau reports are sent to each of the Census Bureau's 12 regional offices and the 43 Department of Commerce district offices. Appendix B (pages 36-38) gives addresses of these offices.

Statistics are also provided on computer tape and microfiche. Microfiche is such an efficient and permanent storage medium that all of the printed final reports will also be available from the Subscribers Services Section on microfiche. Even reports that are out of print can be obtained on microfiche. In addition, a substantial amount of the data on the computer tapes will be transferred directly from the magnetic tape to microfiche. As paper becomes increasingly expensive and difficult to obtain, the Census Bureau can be expected to provide more tabulations on microfiche alone.

Computer tape

Since 1970, more census data have been sold on computer tape than any other medium. After 1980, at least 90 percent of all census data tabulations purchased will be on computer tape. For those with access to a computer, which includes a growing number of users, this medium is the most inexpensive and efficient way to buy census data.

Most census computer tapes are called "summary" tapes because they contain only tabulations of data summarized for various geographical areas. Beginning in late 1980, summary tape data will be available for public use in five sets of tapes known as summary tape files (see Appendix A, page 35). Like the printed report series, the later

Figure 3. Census Printed Reports and Computer Tapes

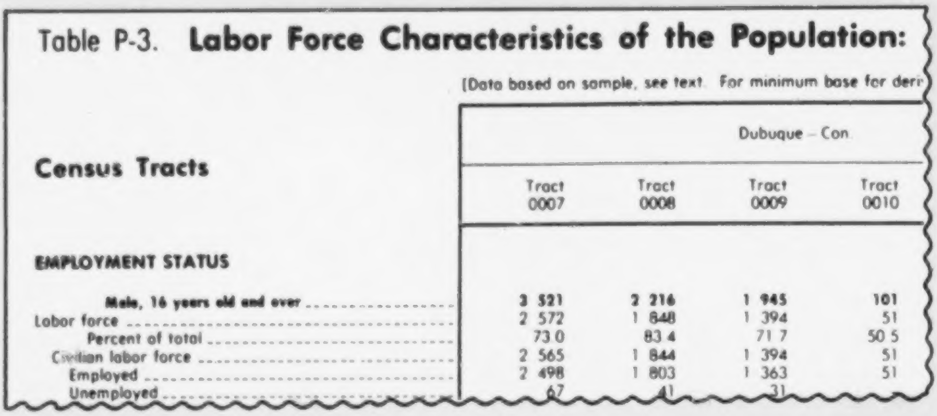
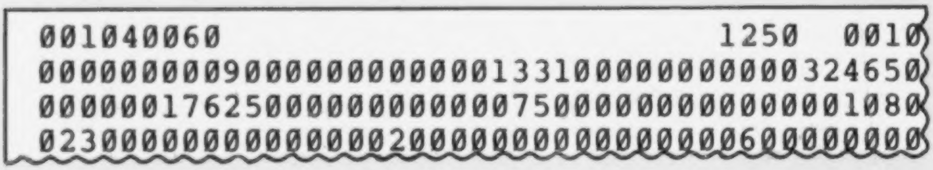


Table P-3. **Labor Force Characteristics of the Population:**

(Data based on sample, see text. For minimum base for deri

Census Tracts	Dubuque – Con			
	Tract 0007	Tract 0008	Tract 0009	Tract 0010
EMPLOYMENT STATUS				
Male, 16 years old and over	**3 521**	**2 216**	**1 945**	**101**
Labor force	2 572	1 848	1 394	51
Percent of total	73.0	83.4	71.7	50.5
Civilian labor force	2 565	1 844	1 394	51
Employed	2 498	1 803	1 363	51
Unemployed	67	41	31	

Sample of a census printed report. This shows how data are printed for each of the approximately 40,000 census tracts in the U.S.



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001040060                         1250  0010
00000000090000000000001331000000000000324650
00000017625000000000007500000000000000001080
02300000000000000200000000000000000600000000
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Census Summary Computer Tape Data. Computer programs convert this raw data into more readable formats.

tape files will contain progressively more detailed information for larger areas. The first two summary tape files will contain only data from the 100 percent questions, but these data will be tabulated for very small units of census geography.

The next three files will contain more detailed tabulations from the long form given only to a sample of the population. The most detailed demographic information will be on the fifth summary tape file, which will contain summaries for only states, very large cities, and metropolitan areas. This last summary tape file should be available by the end of 1982.

Technological advances have enabled the Census Bureau to provide on one reel of tape the same data that in 1970 would have required four reels. Since the price of a reel of computer tape has increased only slightly, the result is that the cost of acquiring a complete set of the publicly available census tapes has been reduced very substantially from what it was after 1970. This cost reduction will enable more researchers than ever before to access the information and certainly broaden the use of census statistics.

Even with the cost reduction, however, the use of computer tapes still requires a fairly high level of technical expertise and a reasonably sized computer. We are not yet at the point where census tapes can be used on small home computers.

Data User Services Division

Recognizing the need to provide technical assistance to the public, the Census Bureau has created the Data User Services Division. With a staff of more than 50 professionals, this division has five separate groups working directly on the 1980 Census products and services. Figure 4 shows the organization of the Data User Services Division. The dotted lines indicate sections with only some program administrative responsibility; staff members of State Data Centers and Summary Tape Processing Centers are not Census Bureau employees, and Regional Data User Services Officers are employees of the Census Bureau's field division.

The **Customer Services Branch** is responsible for selling computer tapes, census maps, and other census-related products. It is in effect the retail store for all census products except printed reports, which are sold by the Government Printing Office. The Customer Services Branch also provides the technical documentation and explanatory material necessary for using computer tapes.

The **User Training Branch** provides a wide variety of conferences and seminars designed to acquaint people with the census and also to train them in the use of census tapes and reports. Beginning in September, 1979, the Bureau will hold a series of more than 100 one-day conferences throughout the country to explain how to obtain and use the statistics from the 1980 Census. More detailed and longer training programs will be held at the Census Bureau's main office in Suitland, Maryland.

Many of these conferences or seminars will be held jointly with one of the Census Bureau's 12 regional offices. In each of these offices there is a full-time person to answer questions about census products (see Appendix B, page 36). The purpose of this regional staff is basically to make it more convenient for someone who needs census information.

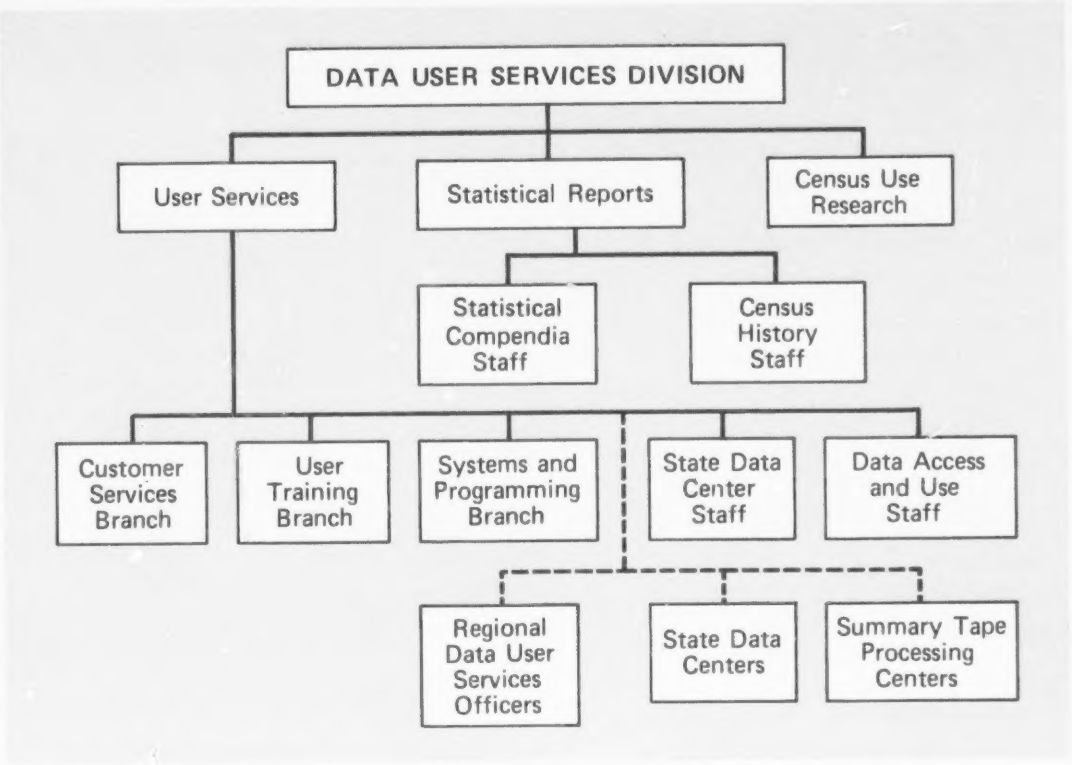
Another program with the same objective is the **State Data Center Program.** This program is a cooperative arrangement with a designated state agency to provide at least one place in each state where people who need census information can go. In addition to having complete census information for that state, each center is expected to provide technical assistance and some training programs. A network of substate affiliated data centers will be established by each of the State Data Centers to more directly assist local governments and people who need data on local areas. An up-to-date list of State Data Centers can be obtained free of charge from the Data User Services Division at the address given at the end of Appendix B (page 38).

The **Data Access and Use Staff** prepare the guides, indexes, and manuals that are useful for, and sometimes essential to, understanding census statistics. These guides, available from the Superintendent of Documents, provide lists of the data tabulations available on tape, microfiche and printed report indexes of the subject matter, and technical explanations of the publicily available computer tapes. Two general and widely distributed booklets are "The Census Users Guide" and the "Introduction to 1980 Census Products & Services."

The **Systems and Programming Branch** is developing publicly available computer programs to process the summary tapes from the census. These programs will perform a variety of tasks such as putting the data into a different format, selecting specific kinds of data, merging data from different tapes, or combining information for different geographic areas. The programs can be purchased early in 1980 so that buyers can try them out on computer tapes made for testing purposes from the Richmond Dress Rehearsal Census.

There are three other groups in the Data User Services Division, which, while not directly involved in 1980 Cen-

Figure 4. Data User Services Division: U.S. Bureau of the Census

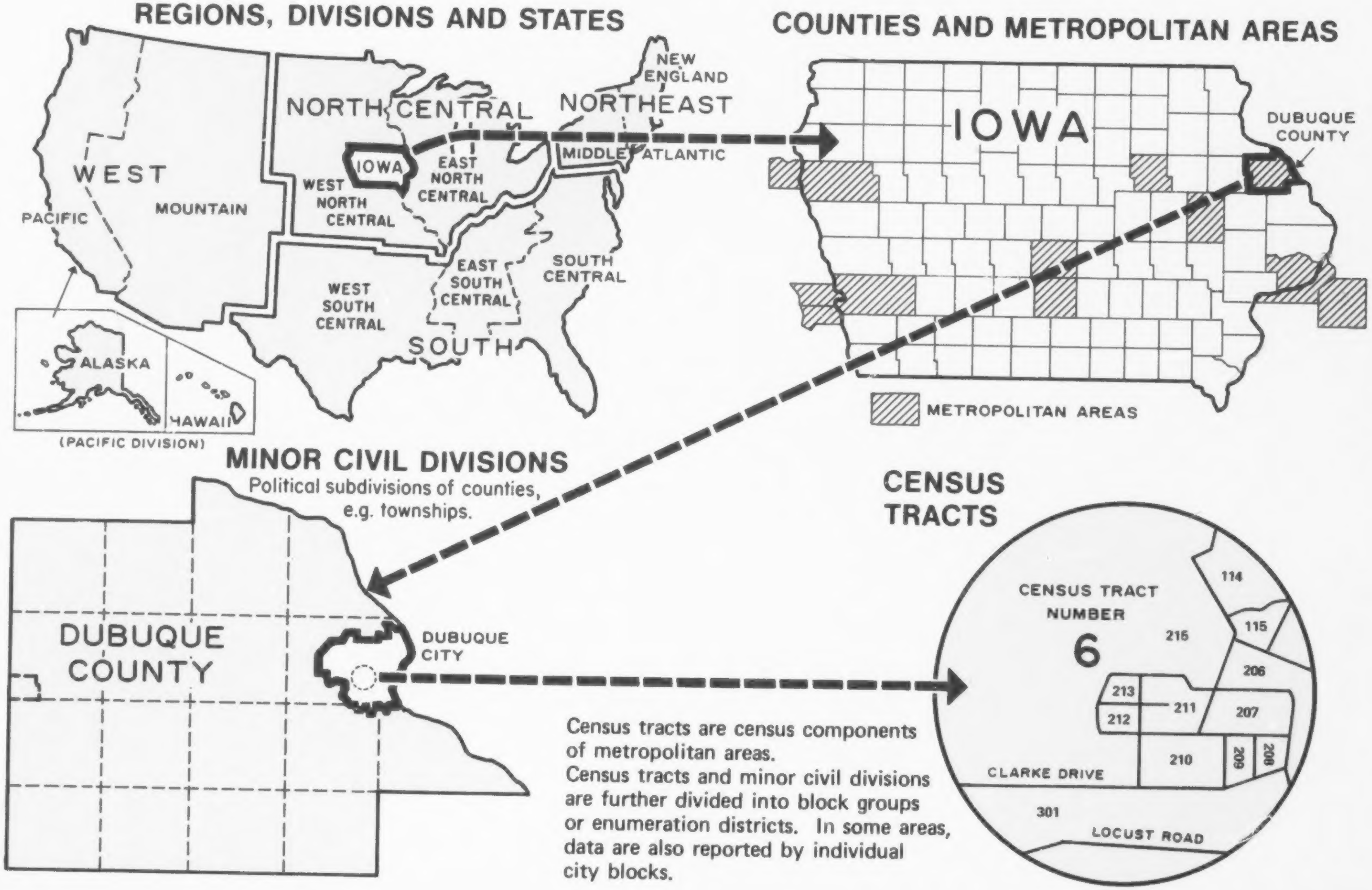

DATA USER SERVICES DIVISION
User Services
Statistical Reports
Census Use Research
Statistical Compendia Staff
Census History Staff
Customer Services Branch
User Training Branch
Systems and Programming Branch
State Data Center Staff
Data Access and Use Staff
Regional Data User Services Officers
State Data Centers
Summary Tape Processing Centers

sus products, perform important functions related to the census. The **Statistical Compendia Staff** annually prepare one of the country's most widely used reference works, the *Statistical Abstract of the United States*. They also compile the *County and City Data Book* as well as several other reference works. The **Census History Staff** prepare a detailed procedural history of each census as well as keeping historical records of other Census Bureau activities. **Census Use Research** conducts basic research into the ways in which census information is put to use, publishing the results.

One of the new programs started after the 1970 Census and continuing for 1980 is the **Summary Tape Processing Center Program.** This program is administered by the **State Data Center Staff** but does not involve Bureau personnel. It is a program for recognizing and listing organizations or individuals who have census computer tapes and are willing to process them for others. There are currently 86 processing centers listed, and more are expected when the 1980 computer tapes become available. An up-to-date list of these centers can also be obtained from the Data User Services Division (Appendix B, page 38).

While the Data User Services Division is set up to answer virtually any question about 1980 Census products, it is not their function to be experts in the data tabulations themselves. This is the role of people in the divisions directly involved with the content of the census —the Population, the Housing, and the Geography Divisions. Within each of these divisions, there are subject-matter specialists who can answer questions

Figure 5. Census Geography



REGIONS, DIVISIONS AND STATES

COUNTIES AND METROPOLITAN AREAS

MINOR CIVIL DIVISIONS

Political subdivisions of counties, e.g. townships.

CENSUS TRACTS

WEST
PACIFIC
MOUNTAIN
NORTH CENTRAL
IOWA
WEST NORTH CENTRAL
EAST NORTH CENTRAL
NORTHEAST
NEW ENGLAND
MIDDLE ATLANTIC
SOUTH
WEST SOUTH CENTRAL
EAST SOUTH CENTRAL
SOUTH CENTRAL
ALASKA
HAWAII
(PACIFIC DIVISION)
IOWA
DUBUQUE COUNTY
METROPOLITAN AREAS
DUBUQUE COUNTY
DUBUQUE CITY
CENSUS TRACT NUMBER
6
114
115
215
206
213
212
211
207
210
209
208
CLARKE DRIVE
301
LOCUST ROAD

Census tracts are census components of metropolitan areas.
Census tracts and minor civil divisions are further divided into block groups or enumeration districts. In some areas, data are also reported by individual city blocks.

about any aspect of the census content. For example, there are specialists in occupational data, income statistics, and migration in the Population Division, and experts in housing characteristics such as value, rent, vacancy, and building type in the Housing Division. The specialists in the Geography Division answer questions relating to such matters as computer mapping, census boundaries, and land area measurements.

A list of the publications of the Data User Services Division is shown in Appendix C (page 39). One of these publications, which is free, *Telephone Contacts for Data Users*, is a list of subject-matter specialists throughout the Bureau of the Census.

Census Geography

There was a simpler time, before computers were in general use, when "all" that the Geography Division of the Census Bureau had to do was prepare by hand the thousands of maps needed for the census. This work is still done by the Geography Division in Jeffersonville, Indiana, but at the same time the Bureau has made a substantial commitment to computer-assisted geographic processing.

The decision to take the 1970 and succeeding censuses primarily by mail required the Geography Division to develop a way to quickly identify addresses within units of census geography. The solution was to create a computerized address coding guide so that, given an individual address, the computer could search a list of address ranges with census geographic codes attached and locate the address with the proper census geography. This address coding guide has been improved and updated to the point where a majority of all 1980 Census questionnaires will be coded to the appropriate geographic area by computer.

The results of the census will be published for many thousands of different geographic areas. First, the data will be tabulated for the U.S. total, the 50 states, the District of Columbia, Puerto Rico, the outlying areas such as Guam, the four census regions, and the nine census divisions. Regions and divisions are groups of states (see Figure 5, upper left corner). There will also be data for 3,137 counties and 285 metropolitan areas (Figure 5, upper right corner).

Towns, townships, and other small political units within counties are called minor civil divisions. All counties are subdivided in some fashion and census data will be published for about 33,000 of these sub-county units (Figure 5, lower left corner). In addition, data will be tabulated for about 20,000 concentrations of population, some incorporated as villages or cities and some with no legal boundaries, all of which are called "places."

All metropolitan areas are subdivided by the Census Bureau into census tracts (Figure 5, lower right corner). These tracts, created for statistical purposes only, contain an average of about 4,000 persons and are designed to be relatively homogeneous in terms of population and housing characteristics. Census tracts and minor civil divisions are further subdivided into block groups or enumeration districts. An enumeration district is the area covered by one enumerator during the census period. It contains an average of about 800 persons, or 250 households. Since most of the census will be conducted by mail, the equivalent of the enumeration district in the mail census areas is the block group. Here enumerator work assignments are sets of addresses. The block group also contains about 800 persons and, as the name suggests, it is made up of a group of city blocks. There will be about 275,000 block groups and enumeration districts for the 1980 Census. The smallest unit of census geography for which data will be available is the city block. Containing an average of only about 60 people, there are two and a half million blocks. All places of 10,000 or more persons will have data for city blocks as well as some additional areas that have specially contracted with the Census Bureau.

Address coding

Every address for which there is a census questionnaire has to be coded with a block number, block group number, census tract number, and a code to identify its appropriate minor civil division, place, county, metropolitan area, and state. This is to make sure that when the questionnaire for 4222 Sheridan Street is tabulated, for example, it is counted as in the block bounded by Sheridan Street, Queens Chapel Road, Tuckerman Street, and Forty-third Avenue. Then this block must be credited to the incorporated place known as University Park and this in turn located in Prince Georges County in the state of Maryland. That address also needs to be counted in its proper block group and census tract. Pre-coding over 70 million addresses in this fashion before the questionnaires are mailed will require 2,000 hours of computer time. For the rest of the some 80 million questionnaires that are expected to be mailed, enumerators will enter this coding by hand when they call to collect the questionnaires, as noted earlier.

The address coding guide (containing ranges of addresses but no individual addresses), which was created by the Census Bureau in order to mail census forms, has been available to the public since the early 1970s. Since then, this innovation has caused a revolution in the processing of address-based information. Thousands of organizations both public and private have been able to process their customer or other address-based records more quickly and efficiently than ever before.

A bank, for example, can classify its customer list by census tracts using the address coding guide. By examining demographic data for these tracts, banks can locate their markets precisely and know where the best places are to put new branches or automated cash dispensing devices.

Municipal governments are also large users of address coding. The address of each theft or other criminal act recorded by the locality can be located by city block to quickly identify high crime areas and reassign police patrols. Also, by coding welfare records, caseworkers can be more efficiently assigned to neighborhoods. A large city carries on many public functions and the ability to use census geographic tools to match addresses from, say, building permit files with those of utility records, permits great flexibility and provides an opportunity to improve service without additional cost.

The address coding guides and address matching programs to be used in the 1980 Census will be available to the public in late 1979. The extension of the area covered by the address coding guides and other technical improvements will substantially increase the value of this innovation in geographical processing. However, in spite of this computerized revolution, the Census Bureau still continues to regard individual addresses as confidential and never sells or otherwise provides them to persons or organizations outside the Census Bureau.

The whole array of coding guides, matching programs, and other computerized geographical products is known as GBF/DIME, which stands for Geographic Base Files/Dual Independent Map Encoding. The intricacies of GBF/DIME are often the subject of training programs given by the Data User Services Division. Several updated booklets explaining the technical details will also be available in the coming months from the Subscribers Services Section.

Many of the computerized geographic products for the 1980 Census are prepared through a cooperative effort between the Census Bureau and local government organizations. Local agencies in some 236 of the country's 285 metropolitan areas have actively participated for several years in creating, updating, or expanding the geographic base files for their communities. Having local people carry out this work provides significant improvements in the data quality since they are the most knowledgeable about their area. Early local involvement also creates the best possible environment for local review of the census results, thereby improving the overall quality of the census data.

1985 and Beyond

If the census is so important, why is there only one every ten years? That question has been asked every decade since the days of Ulysses S. Grant. Reapportionment is the answer, in large part. Redefining Congressional district boundaries is such a monumental and politically disruptive task that few people want to do it more than once every ten years.

But in 1976 Congress passed legislation mandating a census every five years beginning in 1985, but specifically prohibiting the mid-decade census from being used for reapportioning seats in the House of Representatives. In fact, the law does not require that the census of 1985 be exactly like the 1980 Census. The law is quite flexible on the way the mid-decade census can be taken, so long as the basic objectives are met of providing the data on population and housing characteristics needed for fund allocation and program administration.

Considering the billion-dollar price tag for the 1980 Census, it is very unlikely that the 1985 Census will be a complete count in the sense of giving a questionnaire to every household. It probably will be a sample census larger than the 50,000 households surveyed each month for the Current Population Survey, but smaller than the approximately 18 million households given a sample questionnaire in 1980. There certainly will be a printed report, microfiche, and computer tape publications program for 1985 but it will be smaller than that for the decennial census. Data from the 1980 Census will be published for city blocks; the smallest unit of geography for the mid-decade census probably will be large cities.

The authorization for a mid-decade census serves to confirm the Census Bureau's growth from an obscure branch of the Commerce Department to the central part of an emerging federal statistical system. Collecting and processing federal information are sure to become more centralized and coordinated with the growing demand for data for decision-making and the development of micro-computing to make using data a management tool.

Recently retired census planner David L. Kaplan has written:

> "The census is no longer merely the source of interesting facts to put in the *Statistical Abstract* or an encyclopedia. It is now an action instrument which is critically involved in how the national pie—social, economic and political—is cut. This new role for the census, and of the Bureau of the Census, has changed the nature of the job and therefore the professional lives of those of us who work at it. Our shadowy existence in a world of passionate anonymity is gone.
>
> The press and the public are beating a path to Suitland [Census Bureau headquarters]; so are mayors and Indian tribal leaders, the poor and the handicapped, the academicians and the planners, as well as the purveyors of statistical information, both retailers and wholesalers."

In its new role, the census comes in for its share of criticism and public scrutiny. Those who use demographic data may believe not enough information is collected or that it is made available too slowly and without sufficient explanation. Others may feel the census is too intrusive, that it favors some interests but ignores others, or costs too much to administer.

These charges are not new, but they have taken on a new intensity as the value of the data produced by the Census Bureau rises. Every census is subject to attack because it is such a large-scale and public event, and the Census Bureau is ill-equipped for political combat. The figures it produces may be used to allocate tens of billions of dollars, but the Bureau's actual budget is never more than a small fraction of one percent of federal expenditures. It commands the allegiance of no single slice of American society and has no interest group which works in its behalf. Rather, as its slogan suggests, the Bureau sees itself as "fact finder for the nation"—more of a messenger bringing information than a central decisionmaker.

The undercount

With new visibility, issues arise that never seemed that important before. One of those issues is the undercount. When only 97.5 percent of the population is counted in a census, the estimated 2.5 percent missed is called an undercount. Since so much money is now tied to the population count, there has been considerable discussion about adjusting for this undercount so that some areas will not lose funds to which they would be entitled if the count were perfect.

The only reason we know that there is an undercount is because the Census Bureau makes such an estimate based on the previous census in conjunction with administrative statistics. Various methods have been suggested for adjusting for the undercount, but questions arise with any method. For example, since there is a differential undercount between blacks and whites, males and females, old and young, should there be differential adjustments for each of these groups? If so, what about other population sub-groups?

In the end, differential undercount adjustments could come to be expected for hundreds of population groups and for each of tens of thousands of geographical units. It would be a truly monumental task—with the possibility of as much error as that caused by the undercount in the first place.

Adjustment for an undercount is fundamentally a political decision. But it is important that the data, however adjusted, not become "politicized." One of the reasons census figures have become so important in public allocation formulas is that they are free from any political or programmatic bias.

Other agencies with a specific program to administer also gather statistics about their activities, but the natural tendency is for them to avoid gathering or publishing figures that might reflect badly on the agency's performance. Moreover, these agencies generally gather data from institutions, or users of services, whereas the Census Bureau counts everyone in a census, or in a survey queries individuals selected at random from a sample which covers the entire population. Federal spending programs develop loyalists and constituencies who generally do not like to admit that there may no longer be a need for their programs. The Bureau of the Census, on the other hand, exists by law to gather statistics only with regard to their timeliness, usefulness, and accuracy.

New pressures

The Census Bureau may be an innocent victim of the fragmentation of American society in the past decade. Those groups which David Kaplan describes as beating a path to the Census Bureau's door represent different interests, each with its own vision of society and its own needs.

In the past, it has been the role of political leadership to divide the national pie. The choices were simpler, because society was simpler. Now, in the words of Bryant Robey, editor of *American Demographics*, "National statistics may be replacing national consensus as the basis for public policy. If political leadership cannot summon the support of the American people as whole, the result is that it must mediate among the competing claims of different groups for a share of federal benefits."

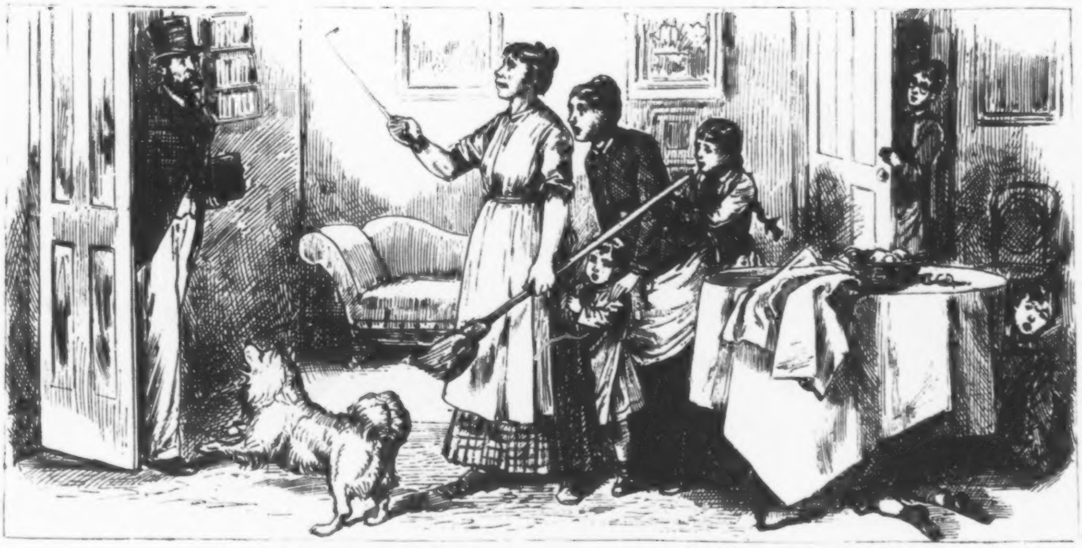
Census statistics may offer federal officials a rational basis for making allocation decisions, but "the focus of debate then shifts from those who make the decisions to those who gather the statistics. This trend is forcing the nation's chief statistical agency to change rapidly," Robey has written.

How the Census Bureau will survive these new pressures is as yet unclear. American society is not likely to return to simpler days, nor is the Census Bureau likely to return to its earlier days. Although the Bureau has faced scrutiny every ten years, the 1980 Census is a watershed because it is the first to be taken since passage of the revenue-sharing program, which for the first time allows for wholesale shifts in funds from federal to local levels without a programmatic base. It is also being taken at a time of growing attention to different ethnic groups, to the equality of women, to concern for the handicapped, and to public suspicion and scrutiny of the role of the federal government.

This is also a census that will measure some of the most dramatic demographic changes in our nation's history. Though many of the shifts are known already, the 1980 Census will be the first time these data have been gathered on a national scale in such depth.

This confluence of events—demographic, political, and statistical—will together make the 20th decennial census of 1980 the most dramatic, important, and closely observed in U.S. history since the first census of 1790. Its results may not make a best seller and they won't be made into a TV special to challenge the record audience of "Roots." But you will be using them and reading about them for years—until the next census. □

CENSUS
'80
APRIL 1



"Wonderful effect of the appearance of the census enumerator."

Early decennial censuses beginning in 1790 were ad hoc affairs conducted by U.S. Marshalls. Special census agents were hired for the first time in 1880, as illustrated in the above cartoon published in that year. In an essentially rural, lightly populated country, the census was far from the massive operation it has become.

Appendix A. Printed Reports and Computer Tapes for the 1980 Census

Population and Housing Census (PHC) Series

PHC(P)	*Preliminary Population and Housing Unit Counts.* Preliminary population and housing unit counts. Summer-Fall 1980.*
PHC(V)	*Final Population and Housing Unit Counts.* Advance official population and housing unit counts. Fall 1980-Winter 1981.
PHC(1)	*Block Statistics.* 100-percent population and housing data for blocks in blocked areas. Winter-Summer 1981.
PHC(2)	*Census Tracts* 100-percent and sample data. Fall 1981-Summer 1982.
PHC(3)	*Summary Characteristics for Governmental Units.* 100-percent and sample data. Fall 1981-Spring 1982.

Population Census (PC) Series

PC(1)-A	*Number of Inhabitants.* Population counts. Fall 1980-Spring 1981.
PC(1)-B	*General Population Characteristics.* 100-percent data. Winter-Summer 1981.
PC(1)-C	*General Social and Economic Characteristics.* Sample data. Fall 1981-Spring 1982.
PC(1)-D	*Detailed Population Characteristics.* Sample data. Fall 1981-Spring 1982.
PC(2)	*Subject Reports.* Tentative release: 1982.

Housing Census (HC) Series

HC(1)-A	*General Housing Characteristics.* Counts of housing units and 100-percent housing data. Winter-Summer 1981.
HC(1)-B	*Detailed Housing Characteristics.* Sample data. Fall 1981-Spring 1982.
HC(2)	*Metropolitan Housing Characteristics.* Sample data. Fall 1981-Fall 1982.
HC(3)	*Subject Reports.* 1982.
HC(4)	*Components of Inventory Change.* 1982.
HC(5)	*Residential Finance.* 1982.

Public-Use Computer Summary Tape Files (STFs)

STF 1	Population and housing counts and limited 100-percent characteristics down to the block level. Fall 1980-Summer 1981.
STF 2	General 100-percent characteristics down to the tract level and for places of 1,000 or more population. Winter-Summer 1981.
STF 3	Sample tabulations for ZIP Code areas, enumeration districts, and block groups. Fall 1981-Spring 1982.
STF 4	General sample tabulations down to the tract level. Fall 1981-Spring 1982.
STF 5	Detailed sample tabulations for states, SMSAs (metropolitan areas), large cities, and counties. Spring-Fall 1982

---

*Tentative availability dates are provided as ranges of dates since data for some states will be tabulated and released before other states, depending on the progress of field and coding operations.

Appendix B. Regional Data User Services Officers and U.S. Department of Commerce District Offices

Regional Data User Services Officers

ATLANTA
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Bureau of the Census
1365 Peachtree Street, N.E., Room 625
Atlanta, Georgia 30309
(404) 881-2274

BOSTON
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441 Stuart St., 10th Floor
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Charlotte, North Carolina 28202
(704) 371-6144

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Steve Laue
Bureau of the Census
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Chicago, Illinois 60604
(312) 353-0980

DALLAS
Valerie McFarland
Bureau of the Census
1100 Commerce Street, Room 3C54
Dallas, Texas 75242
(214) 749-2394

DENVER
Gerald O'Donnell
Bureau of the Census
575 Union Blvd., P.O. Box 25207
Denver, Colorado 80225
(303) 234-5825

DETROIT
Timothy Jones
Bureau of the Census
Federal Bldg. & U.S. Courthouse, Rm. 565
231 W. Lafayette Street
Detroit, Michigan 48226

KANSAS CITY
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Bureau of the Census
One Gateway Center
4th and State Streets
Kansas City, Kansas 66101
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Albuquerque, New Mexico 87102

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Anchorage, Alaska 99501

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Atlanta, Georgia 30309

BALTIMORE
Room 415, U.S. Customhouse
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BIRMINGHAM
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Birmingham, Alabama 35205

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Boston, Massachusetts 02116

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Buffalo, New York 14202

CHARLESTON
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Charleston, West Virginia 25301

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Cheyenne, Wyoming 82001

CHICAGO
55 East Monroe St.
Chicago, Illinois 60603

CINCINNATI
550 Main St.
Cincinnati, Ohio 45202

CLEVELAND
666 Euclid Ave.
Cleveland, Ohio 44114

COLUMBIA
2611 Forest Dr.
Columbia, South Carolina 29204

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1100 Commerce St.
Dallas, Texas 75242

DENVER
Room 165, New Customhouse
Denver, Colorado 80202

DES MOINES
210 Walnut St.
Des Moines, Iowa 50309

DETROIT
Room 445, Federal Bldg.
Detroit, Michigan 48226

GREENSBORO
Room 203, Federal Bldg.
Greensboro, North Carolina 27402

HARTFORD
450 Main St.
Hartford, Connecticut 06103

HONOLULU
300 Ala Moana Blvd.
Honolulu, Hawaii 96850

HOUSTON
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Houston, Texas 77002

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Indianapolis, Indiana 46204

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Los Angeles, California 90049

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Memphis, Tennessee 38103

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Miami, Florida 33130

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517 E. Wisconsin Ave.
Milwaukee, Wisconsin 53202

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110 S. Fourth St.
Minneapolis, Minnesota 55401

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4th Floor, Gateway Bldg.
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Other sources of 1980 Census information (see text, pages 26 and 27):

The list of **State Data Centers** and **Summary Tape Processing Centers** changes frequently. An up-to-date list can be obtained without charge from:

Martha Wyeth
Data User Services Division
Bureau of the Census
Washington, D.C. 20233
(301) 763-2400

Appendix C. Census Reference Works

The following publications are available from:

Subscribers Services Section (Publications)
Bureau of the Census
Washington, D.C. 20233
(301) 763-7472

The 1980 Census—Introduction to Products and Services, October 1979.

The 1980 Census Users Guide, October 1979.

Index to 1980 Census Tapes and Publications.

The Subscribers Services Section can also supply publication order forms, free of charge, which include prices and availability for the above three reference works, all the census reports listed in this Appendix, and most other census-related government publications.

Telephone Contacts for Data Users, 4 pages, updated periodically, free.

1980 Census Update, quarterly supplement to the *Data User News*, free.

Data User News, monthly newsletter, $4.00 per year, single copies 25 cents each.

Factfinder for the Nation, issued irregularly, each issue 4 pages, topics include population, housing, and geography, 25 cents each.

Data Access Description No. 37: Current Survey Statistics Available from the Bureau of the Census, May 1977, $1.30. Other *Data Access Descriptions* will be available that describe various aspects of the 1980 Census.

Reference Manual on Population and Housing Statistics from the Census Bureau, April 1977, $2.00.

The following publications are available from:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402
(202) 783-3238

Bureau of the Census Catalog, GPO No. C3.163/2, annual with monthly and quarterly supplements, $19.00 per year.

Statistical Services of the United States Government 1976, GPO No. 041-001-00100-0, 234 pages, $3.40.

Federal Statistical Directory 1976, GPO No. 041-001-00125-5, 248 pages, $2.50.

The Methods and Materials of Demography, GPO No. 003-001-02289-3, 2 volumes, $15.75 per set.

Statistical Abstract of the United States 1978, GPO No. 003-024-01647-8, 1,057 pages, $8.00.

County and City Data Book 1977, GPO No. 003-024-00121-7, 1,011 pages, $19.50.

The following publications are available from the sources noted:

American Demographics magazine, published monthly except combined July/August and November/December issues, by American Demographics, Inc., P.O. Box 68, Ithaca, N.Y. 14850. April 1979 was a special issue on the census and there is a monthly column which discusses various aspects of the 1980 Census. $30.00 per year, single copies $4.00 each.

Counting the People in 1980: An Appraisal of Census Plans, by the National Research Council, Office of Publications, National Academy of Sciences, 2101 Constitution Avenue N.W., Washington, D.C., 20418, $7.25.

Information and Allocation: Two Uses of the 1980 Census, by Nathan Keyfitz, May 1979 issue of *The American Statistician*, published by The American Statistical Association, 806-15th Street N.W., Washington, D.C., 20005. $10.00 per year, single copy prices on request.

Recent Population Bulletins and PRB Slide Series

Beginning October 1, 1979, the prices for all *Population Bulletins* are $2.00 per single copy; 2-49 copies, $1.75 each; 50 copies or more, $1.50 each. Sets of 35mm colored slides for the figures and tables appearing in the *Bulletin* are available as indicated.

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No. 1 *Infant Mortality—Progress and Problems,* by Leon F. Bouvier and Jean van der Tak

No. 2 *Adolescent Pregnancy and Childbearing—Growing Concerns for Americans,* by Wendy H. Baldwin, May 1977 updated reprint (13 slides, $6.50)

No. 3 *Rural Renaissance in America? The Revival of Population Growth in Remote Areas,* by Peter M. Morrison, with Judith P. Wheeler (6 slides, $3.00)

No. 4 *Can Third World Cities Cope?* by George J. Beier (5 slides, $2.50)

No. 5 *Communicating Population and Family Planning,* by Robert P. Worrall (3 slides, $1.50)

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No. 3 *Changing Contraceptive Patterns: A Global Perspective,* by Dorothy Nortman (13 slides, $6.50)

No. 4 *International Migration: Yesterday, Today, and Tomorrow,* by Leon F. Bouvier, with Henry S. Shryock and Harry W. Henderson, August 1979 updated reprint (13 slides, $6.50)

No. 5 *Marrying, Divorcing, and Living Together in the U.S. Today,* by Paul C. Glick and Arthur J. Norton, February 1979 updated reprint (27 slides, $13.50)

No. 6 *Indonesia's Family Planning Story: Success and Challenge,* by Terence H. Hull, Valerie J. Hull, and Masri Singarimbun (20 slides, $10.00)

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No. 5 *Mexico's Population Policy Turnaround,* by John S. Nagel (10 slides, $5.00)

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Population Bulletin

Our Population Predicament: A New Look

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A publication of the Population
Reference Bureau, Inc.
Vol. 34, No. 5
December 1979

ISSN 0032-468X

Abstract—Issued to mark the Population Reference Bureau's 50th anniversary, this *Bulletin* updates the story of world population presented in its popular predecessor of 1971, "Man's Population Predicament." Estimated at half a billion in 1650, world population reached 2 billion in 1930, 4 billion in 1975, and is projected to be about 6 billion in 2000. Most of today's rapid growth is occurring among the three-quarters of the world's peoples living in less developed countries where the post-World War II gap between high birth rates and falling death rates has only recently begun to narrow. This growth, coupled with high consumption in developed countries, is putting tremendous pressures on Earth's resources, environment, and social fabric. New evidence on Europe's demographic transition and from China, Indonesia, and Thailand in the 1970s suggests that well-designed family planning programs can speed fertility decline but rapid worldwide attainment of replacement-level fertility—an average family of about two children—will also require special development efforts and "beyond family planning" measures. Current projections for the world's ultimate peak population range from 8 billion in the mid-21st century to 11 billion about 2125, depending on when replacement-level fertility is reached. China's drive for a drastic birth rate reduction and the oil crisis might change fertility behavior more rapidly than most demographers have heretofore thought likely.

The *Population Bulletin* is published in six issues per volume and is distributed along with the other publications listed on the back cover to all members of the Population Reference Bureau. If you would like to order additional copies of this *Bulletin* or join the Bureau if you are not already a member, write the Circulation Department, Population Reference Bureau, Inc., 1337 Connecticut Avenue N.W., Washington, D.C. 20036. Individual Bureau memberships are $25 per year; $15 for college teachers; $10 for school teachers; $5 for all students. Rates for school, university, and public libraries are $30; institutions or firms, $100. Single copies of the *Population Bulletin* are $2.00; 2-49 copies, $1.75 each; 50 copies or more, $1.50 each. Colored slides are available for the figures and tables in this *Bulletin*. See inside back cover.

Editor: Jean van der Tak
Assistant Editor: Arthur Haupt
Graphics: James O'Brien

The suggested citation, if you quote from this publication, is Jean van der Tak, Carl Haub, and Elaine Murphy, "Our Population Predicament: A New Look," *Population Bulletin*, Vol. 34, No. 5 (Population Reference Bureau, Inc., Washington, D.C., 1979). The figures and tables from this *Bulletin* may be freely reproduced provided credit is given to the Population Reference Bureau and a copy of the publication in which they appear is forwarded to the Bureau.

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Our Population Predicament: A New Look

By Jean van der Tak, Carl Haub, and Elaine Murphy

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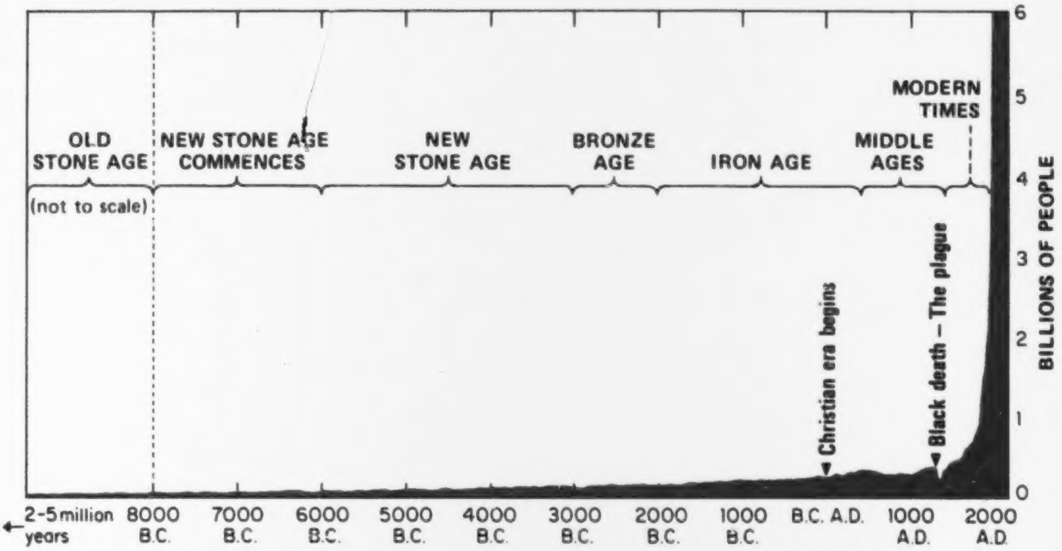
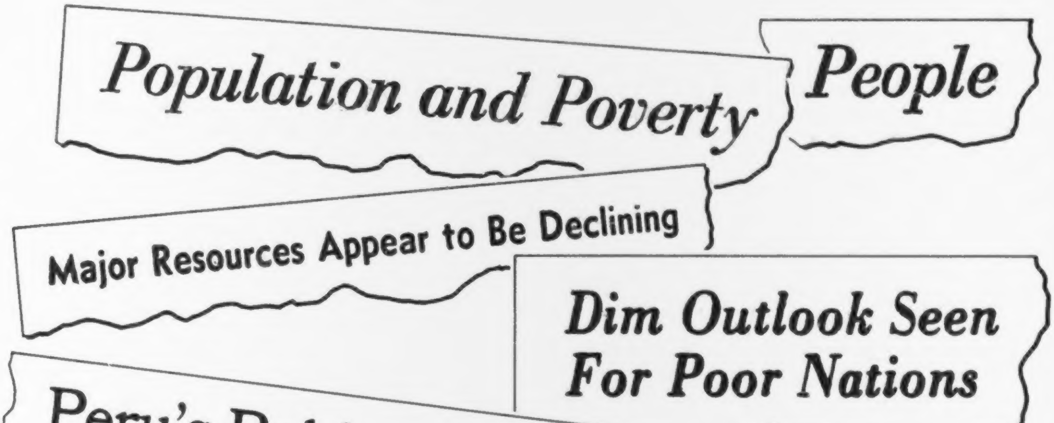
POPULATION BULLETIN
Vol. 34, No. 5, December 1979

Figure 1. World Population Growth Through History





Population and Poverty

People

Major Resources Appear to Be Declining

Dim Outlook Seen For Poor Nations

Peru's Babies Are Dying

More Crowding Forecast In World's Poorer Cities

Human numbers took two to five million years to reach their first billion, about 1800 A.D. By 1975, 175 years later, the figure was up to four billion. Adding the next two billion could take only 25 years, according to current projections. Today's population explosion is putting tremendous pressures on Earth's resources, environment, and social fabric.

Our Population Predicament: A New Look

By **Jean van der Tak,**
Carl Haub, and **Elaine Murphy**

Population Reference Bureau, Inc.

About this Bulletin

Published in April 1971, "Man's Population Predicament," by the Population Reference Bureau's then President and Editor, Rufus E. Miles, Jr., was one of the most widely quoted and distributed of the Bureau's 40-year series of Population Bulletins. *In graphic words and charts, Mr. Miles described the origins and implications of the post-World War II global population explosion. Among the first to see that explosion looming was Guy Irving Burch when he founded the PRB in 1929. Hailed as a "demographic Paul Revere," warning that* people are coming!, *Burch appears to have coined the very term "population explosion" in his November 1950* Population Bulletin, *"A Winning Program for Democracy," later condensed in* Reader's Digest. *Burch was cited with the Lasker Award after his untimely death in January 1951: "Perhaps more than any other individual he was responsible for today's awareness of the population problem and the need for positive action to resolve it."*

This "new look" at our population predicament is issued as a tribute to Guy Irving Burch; to PRB's 50 years of "telling the world about population"; and in recognition that awareness of the population problem, though growing, is needed more than ever as the 1980s dawn, along with much more positive and immediate action to resolve it.

To conclude this update, Rufus Miles has provided a thoughtful look at what he sees as the intensified "Age of Discontinuity" which the world is now entering as China aims for a drastic reduction in its birth rate and the era of cheap petroleum comes to an end.

Jean van der Tak is PRB's Director of Publications, Carl Haub is Staff Demographer, and Elaine Murphy is Director of Population Education. Jean van der Tak and Carl Haub are graduates of the Master's Degree Program in Demography of the Center for Population Research, Georgetown University. Dr. Murphy holds the Ph.D. in Human Development from the University of Maryland.

The authors are grateful for the helpful comments and suggestions received in the preparation of this Bulletin *from Leon Bouvier, Marshall Green, Rufus Miles, Conrad Taeuber, and their colleagues on the PRB staff. Parts of the* Bulletin *draw upon the excellent review of the current world population situation by Ambassador Marshall Green, former U.S. Department of State Coordinator of Population Affairs, and Robert Fearey, "World Population: The Silent Explosion,"* Department of State Bulletin *(Department of State Publication 8956, October 1978).*

The human population of the earth probably passed the 4.3 billion point in 1979, increasing by some 74 million each year. We say "probably" because population data are still scanty and unreliable for parts of Asia and Africa although demographers are becoming adept at making plausible estimates from deficient data. At its current 1.7 percent rate of increase, every three years the world population grows by nearly as many people as the 220 million living in the U.S. in 1979. Every five days we add another million people to our human population.[1]

This population explosion seems all the more awesome when seen in the perspective of humanity's development as a species. During the hundreds of thousands of years of the Old Stone Age when *homo sapiens* was a hunter and food gatherer, the world population

Table 1. Estimated Timing of Each Billion of World Population

	Time taken to reach	Year attained
First billion	2-5 million years	About 1800 A.D.
Second billion	Approx. 130 years	1930
Third billion	30 years	1960
Fourth billion	15 years	1975
Projections:		
Fifth billion	12 years	1987
Sixth billion	11 years	1998

Sources: United Nations, *The Population Debate: Dimensions and Perspectives. Papers of the World Population Conference. Bucharest, 1974.* Vol. 1, Population Studies No. 57 (1975) Table 1, *Demographic Yearbook 1962* and *1969*, and *World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment.* ST/ESA/SER.R/33(1979); and, John D. Durand, "Historical Estimates of World Population," *Population and Development Review*, Vol. 3, No. 3 (September 1977) pp. 253-296.

probably never exceeded 10 million. Somewhere about 8,000-6,000 B.C., humans learned how to grow food and create settlements and eventually cities. The shift from food gathering to food growing was a momentous change: far larger numbers could be supported. By the time of Christ, 1 A.D., world population had grown to about 300 million and by 1650 A.D. reached an estimated 500 million.

The increase from about 10 million at the beginning of the agricultural era to 500 million some 8,000-10,000 years later—a fifty-fold increase—was a "population explosion" in itself. This term, however, applies with greater accuracy to the far more rapid gain that has occurred in the past three and a quarter centuries and particularly in the 35 years since World War II (see Figure 1). The world reached its first billion around 1800—some two to five million years after the appearance of the first humanlike creatures.[2] Adding the second billion took about 130 years to 1930. The third billion was reached after only 30 years, in 1960, and the fourth after 15 years, in 1975 (Table 1). About 1965, the world's rate of population growth climbed to 2 percent—a rate at which numbers double in 35 years. That growth rate has now fallen slightly and is expected to continue to decline, although at an unknown pace. Even so, world population is projected to be about 6 billion by the year 2000, when the numbers being added each year could be well over 90 million. (The box on the opposite page explains some of the arithmetic involved in this growth.) The level at which mankind's total numbers will ultimately peak now appears to lie between 8 and 11 billion, depending on the determination with which the world addresses the problem.

Global population growth occurs as a result of the excess of births over deaths. Most of today's growth is taking place among the some three-quarters of the world's population living in the less developed regions—Latin America, Africa, and Asia (minus Japan). Here, previously high death rates fell rapidly after World War II and by about 1977 were at the comparatively low level of 12 deaths per 1,000 population per year. Birth rates, though beginning to fall—rapidly, in some cases—are still at an average 33 per 1,000 population annually. As a result, the developing regions are growing at a rapid 2.1 percent each year. By contrast, among the other quarter of the globe's population in de-

Demographic Arithmetic

Growth rates

Most growth rates referred to in this *Bulletin* are the *rate of natural increase*—annual births minus deaths per 1,000 population, expressed as a percentage. For example:

About 1977, the world had a birth rate of 28 per 1,000 population, a death rate of 11 per 1,000, and therefore, by subtracting 11 from 28, a natural increase rate of 17 per 1,000, or 1.7 percent.

For a country or region, as opposed to the world, a true *population growth rate* adds in the effect of net immigration or emigration. For example:

In 1978, the U.S. had a natural increase rate of 0.6 percent and a population growth rate of 0.8 percent, taking into account net legal immigration. (Illegal immigration adds more to the U.S. population growth rate, but the exact amount is unknown.)

Doubling time

One way to grasp the implications of a particular rate of population growth is to consider how long it would take a population growing at that rate to double. A 1 percent growth rate means a doubling in 69 years; a 2 percent rate results in a doubling in 35 years; and a 3 percent rate doubles a population in 23 years. A quick way to calculate a doubling time is to divide 69 by the percentage of growth. For example:

If the world's 1.7 percent population growth rate of 1979 were to remain constant, the current population of 4.3 billion would double to 8.6 billion in 41 years (69 ÷ 1.7 = 40.6).

Annual growth rate (%):	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Years to double population:	69	46	35	28	23	20	17

Growth rate versus numbers added

Even though a population's growth *rate* may decline, the *actual numbers of people added* each year may increase, because the base population is becoming larger and larger. For example:

In 1979, the world's population growth rate of about 1.7 percent applies to a global population of 4.3 billion for a gain of 73.5 million people each year (.017 x 4.321 billion = 73.5 million). About 2000, the United Nations projects that the world's population growth rate will be down slightly to 1.5 percent but the total population will be about 6.2 billion so that the numbers added each year will be up to 93 million (.015 x 6.199 billion = 93.0 million). See figure below.

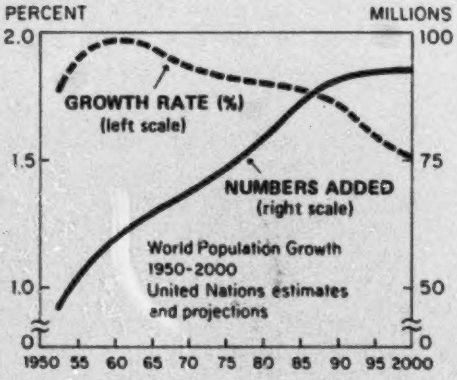


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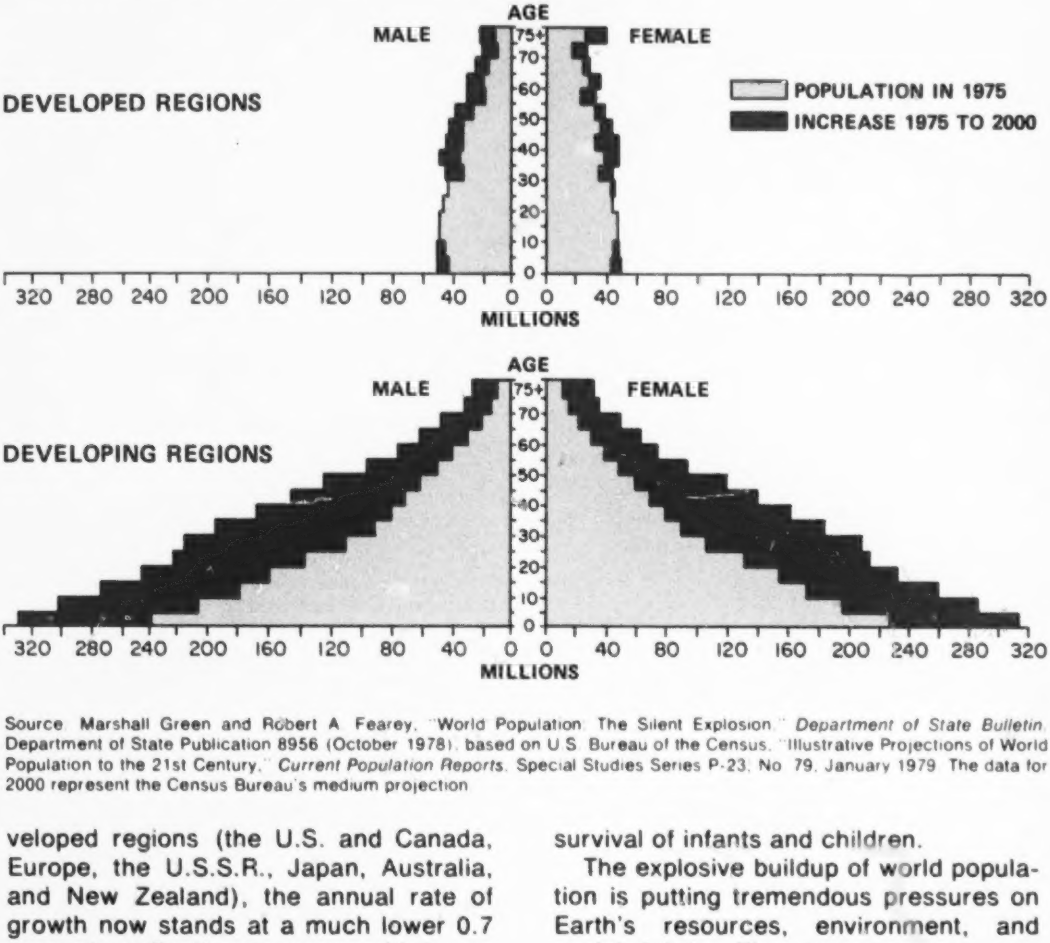
Figure 2. Population Age Pyramids: Developed and Developing Regions, 1975 and 2000



Source: Marshall Green and Robert A. Fearey, "World Population: The Silent Explosion," *Department of State Bulletin*, Department of State Publication 8956 (October 1978), based on U.S. Bureau of the Census, "Illustrative Projections of World Population to the 21st Century," *Current Population Reports*, Special Studies Series P-23, No. 79, January 1979. The data for 2000 represent the Census Bureau's medium projection.

veloped regions (the U.S. and Canada, Europe, the U.S.S.R., Japan, Australia, and New Zealand), the annual rate of growth now stands at a much lower 0.7 percent—reflecting an average birth rate of 16 per 1,000 and a death rate of 9 (1977 estimates). Figure 2 brings out strikingly the differences in current population size between the developed and the developing regions and the impact of their differential growth rates. Between 1975 and 2000, the population of developed regions is expected to grow slowly while that of the developing regions expands enormously. Much of the developing regions' growth will be due to their much larger proportions of young people now in or about to enter their childbearing years—the result of continuing high fertility and greatly improved survival of infants and children.

The explosive buildup of world population is putting tremendous pressures on Earth's resources, environment, and social fabric. The pressures are currently felt most acutely in developing regions where hundreds of millions already live in abject poverty and hunger. But the pressures are compounded by the developed countries' high per capita consumption of resources and output of pollution. The population predicament is shared by all humanity.

This *Bulletin* sketches the development of the predicament in modern times, Europe's "demographic transition" from high to low birth and death rates, the implications of that great shift for today's high-fertility, developing nations, and the beginnings of their transition. Sections follow on the consequences of rapid population growth and the worldwide response to the problem so far. The conclusion discusses prospects for the future and the approaches now being proposed to hasten attainment of global zero population growth before human numbers overshoot Earth's sustaining capacity.

The Explosion Takes Off

What has fueled the takeoff of world population growth in modern times? Population growth in global terms can come about in only one way—when births exceed deaths. This simple relationship is expressed in the "balancing equation" all students of population learn:

Population (at a later date) =
Population (at the earlier date) + (births - deaths)

It is evident from Figure 1 (page 2) that, beginning about 1650, the excess of births over deaths worldwide must have become larger and larger.

The relationship in the equation, although quite basic, represents a more complex series of causes. Fluctuations in fertility, the number of births a woman *actually has,* obviously affect growth; fecundity, the number of births a woman is *able* to have, varies among populations; and mortality, the rate at which people leave a population through death, has different causes at different times in different areas. Improved fecundity brought about by better nutrition and disease control has played something of a role in modern population growth—in Western Europe during the 18th and early 19th centuries, for example, and in Sub-Saharan Africa today. Increased fertility played a role in the galloping growth of the U.S. and Canada during the 19th century: with the availability of seemingly boundless land, the millions of migrants who crossed the Atlantic were encouraged to produce larger families than their parents and grandparents often dared in land-short Europe.[3] But it is falling mortality that has been chiefly responsible for the sudden spurt in world population growth since about 1800.

Lower mortality means not only more population growth because people are being subtracted more slowly by death but also more births because more young people survive to and through their years of fertility. The devastating effect of high mortality on potentially fertile young people in past times is illustrated by the following:

> "Abraham Lincoln's mother died when she was thirty-five and he was nine. Prior to her death she had three children: Abraham's brother died in infancy and his sister died in her early twenties. Abraham's first love, Anne Rutledge, died at age nineteen. Of the four sons born to Abraham and Mary Todd Lincoln, only one survived to maturity. Clearly, a life with so many bereavements was very different from most of our lives today."[4]

The mortality revolution

Humanity's first real control over pestilence (infectious disease) and famine—the scourges which, along with war, had kept death rates close to high birth rates throughout human history—took hold in Western Europe as the Industrial Revolution gathered steam in the late 18th century and early 19th century and spread to North America by the mid-19th century. This mortality revolution was triggered by social and economic changes that accompanied new agricultural technologies and increasing industrialization and urbanization. Improved agricultural techniques boosted food supplies which lessened the danger of famine and improved nutrition. With better nutrition came increased resistance to infection and tolerance of severe illnesses. Living conditions gradually improved as industrialization raised personal incomes. This brought better housing, which reduced diseases associated with crowding, such as tuberculosis, and improved personal hygiene. Soap use went up and people switched from lice-hiding wool to cotton underwear.

Later in the 19th century and on into the early 20th century, public health and medical advances hastened the mortality decline. The need to separate water supplies from sewage was established; pasteurization of milk and smallpox inoculation were introduced; and medicine gradually reached the point where more people were cured by treatment than were killed by pre-antiseptic conditions. The causative factors of a host of ancient killers, including plague, yellow fever, cholera, typhus, dysentery, diphtheria, tuberculosis, and malaria were identified, and the means of controlling them developed.[5]

Death rates began to drop. In the 1840s in several Western European countries, data indicate that only about 85 percent of those born survived the first year of life and about 65 percent lived to age 15. A century later, close to 96 percent survived the first year and about 75 percent lived to age 60. The death rate in the now developed countries dropped from an estimated 28 per 1,000 population in 1850 to 15 in 1950 and 9 in 1977 (Figure 3).

Much of this decline in mortality reflected the greater survival of infants. In Sweden, for example, at the beginning of the 19th century, about 200 of every 1,000 children born failed to survive their first year. This infant mortality rate dropped gradually to 100 deaths per 1,000 live births about 1900 and then more rapidly to 21 by 1950 and about 8 by 1977. Although Sweden's infant mortality rate is now the lowest in the world, other Western countries have had a similar decline.[6]

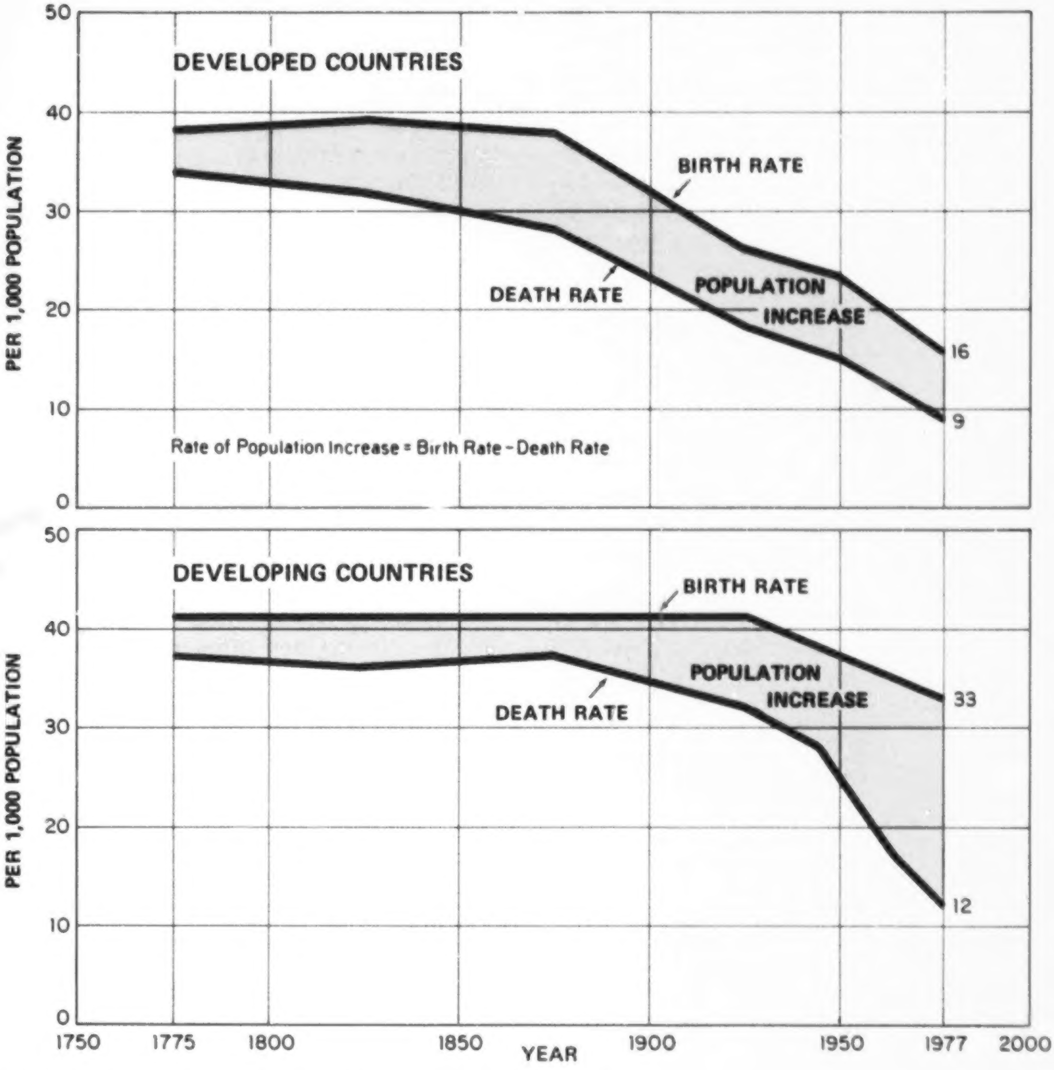
There were setbacks to the now developed world's mortality revolution. In Europe, the Irish potato famine of 1846 took 800,000 lives and the two world wars of the 20th century claimed millions more. But with the near elimination of most serious infectious diseases, the main causes of mortality shifted to the chronic and stress diseases, such as cancer and heart disease, which strike more among older people.

Late in the 19th century, birth rates also started to come down in the more developed countries in tandem with the gradually falling death rates, easing population growth before it could mount to a burdensome level. For Europe, population pressures were also eased by massive migration to the relatively empty lands of the New World—chiefly the U.S. and Canada, Argentina and Brazil, South Africa, and Australia and New Zealand. Between 1820 and 1930, an estimated 55 million Europeans—a quarter of Europe's population—left to seek their fortunes overseas.[7]

The story was different in the less developed world. Until the end of World War II, there was a gradual decline in mortality, probably due to improving water supplies and other public sanitary measures. But estimates indicate that death rates were still close to 30 per 1,000 in the late 1940s.

Following World War II, however, the decline in mortality became much steeper. In Sri Lanka (then Ceylon), for instance, the death rate came down from 20 to 14 in a single year and, in consequence, the estimated life expectancy at birth went up from 43 years in 1946 to 52 years in 1947. In general, in less developed countries, the death rate dropped from an estimated 28 per 1,000 population in the 1940-50 decade to 17 per 1,000 in the 1960-70 decade. The pace of decline has since slowed but, even so, the estimated rate for less developed countries as a whole was down to 12 per 1,000 by 1977 (Figure 3). There are wide regional variations, however. Latin America's death rate of just 8 per 1,000 population is lower than that of most developed countries (including the U.S. at 9 per 1,000), due largely to much higher proportions of young people. Asia's death rate is 11,

Figure 3. Birth and Death Rates: Developed and Developing Countries, 1775 to 1977



Source: Population Reference Bureau, based on United Nations estimates

while Africa's death rate of 17 is the highest of any region.[8]

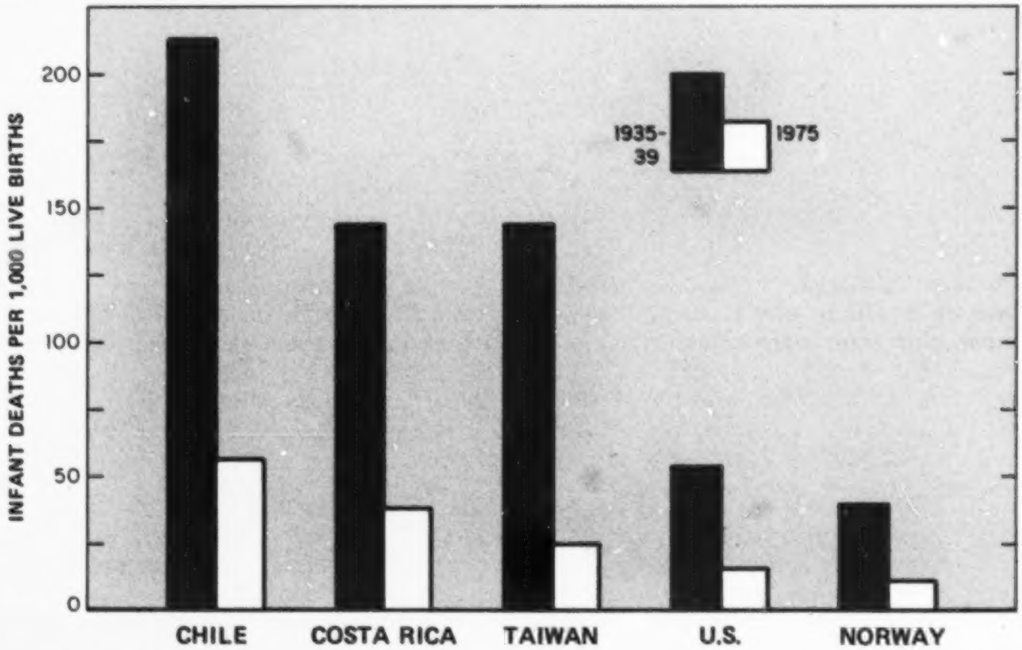
The developing world's mortality revolution was triggered not by social and economic development as in the West, but by medical and public health technology—antibiotics, sanitation, immunization, insecticides (DDT to strike at malaria-bearing mosquitoes, for example), and campaigns against such major killers as smallpox. Much of this technology was imported and applied overnight through international health and foreign aid programs, and food aid cut famine tolls in times of drought. The result was a telescoping into two decades of the mortality decline that had taken a century in the developed world. Birth rates have scarcely had time to adjust and population growth rates have soared.

The reduction in infant mortality has particular significance in terms of the population equation since the survival of children means they will probably become parents themselves. Although deaths among infants in many less developed countries, particularly in Africa, are still five to seven times what they are in industrialized nations, the decline since the 1930s has been dramatic in many cases. For example, as seen in Figure 4, between 1935-39 and 1975, annual infant deaths per 1,000 live births fell from 213 to 56 in Chile and 144 to 25 in Taiwan. In the U.S. in the same period, the decline was from 53 to 16.

Europe's Demographic Transition

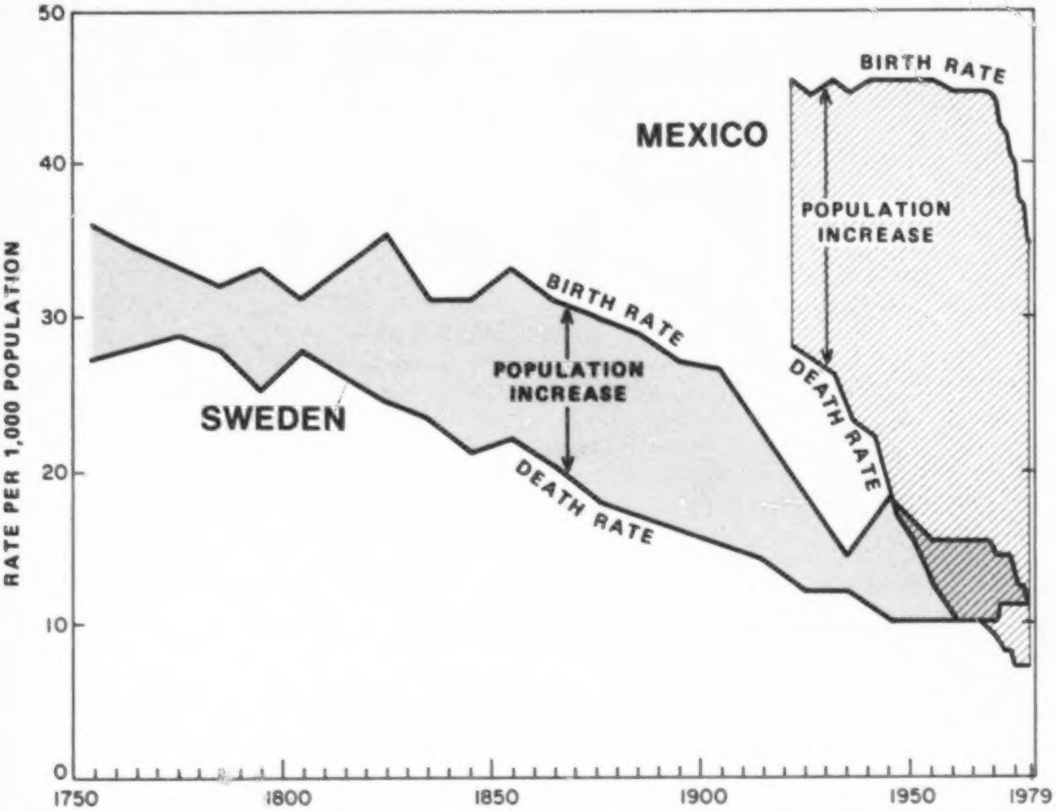
The historical pattern of Sweden's birth and death rates shown in Figure 5 is typical of Western European countries. Until the late 18th century, both rates fluctuated at a relatively high level. Then as the Industrial Revolution accelerated in the early 19th century, the death rate began to fall gradually, followed some 50 to 70 years later by the birth rate. By the 1930s, both were at low levels. Today, following a brief post-World War II rise in the birth rate, Sweden's annual births and deaths are in balance and the population has stopped growing from natural increase. This pattern applies generally to the now developed

Figure 4. Infant Mortality Decline: Selected Countries, 1935-39 to 1975



Sources: Taiwan, 1975: U.S. Bureau of the Census, *Republic of China*, Country Demographic Profile, ISP-DP-12, 1978. All other data: United Nations, *Demographic Yearbook 1966* and *1977*.

Figure 5. Birth and Death Rates: Sweden, 1755-1978, and Mexico, 1920-1979



Sources:

Sweden: 1775-1970, Gosta Guteland et al., *The Biography of a People: Past and Future Population Changes in Sweden* (Stockholm: Royal Ministry for Foreign Affairs, 1974); 1971-78, United Nations, *Demographic Yearbook 1977* and *Monthly Bulletin of Statistics*, September 1979.

Mexico: 1920-72, John S. Nagel, "Mexico's Population Policy Turnaround," *Population Bulletin*, Vol. 33, No. 5 (December 1978) Figure 2; 1973-79, U.S. Bureau of the Census, *Mexico*, Country Demographic Profile, ISP-DP-14, 1979.

countries, although there are exceptions. In the U.S. and Canada, for example, birth rates were higher in the late 18th century and throughout most of the 19th century than they were in Europe, and the post-World War II rise in birth rates was prolonged to the early 1960s. However, now, in the late 1970s, as in most developed countries, the gap between their birth and death rates is narrow: in 1978, in the U.S., the birth rate was 15 per 1,000 population and the death rate was 9, and in Canada, the rates were 15 and 7.

Since the 1930s, demographers have sought to explain how and why this evolution from high to low birth and death rates came about in today's developed countries. The best known explanation, based mainly on what was thought to be the experience in Western Europe, is known as the demographic transition theory. In its "classic" form, this theory describes three stages:

- The *initial stage of potentially high population growth* evolves from a backdrop of high death rates reflecting harsh living conditions and high birth rates needed to compensate for high infant mortality. With improved living conditions and control over disease brought about by "modernization," death rates begin to fall. At first, birth rates remain high, causing a rise in population growth.

- During the subsequent *transitional stage*, the rate of population growth is still relatively high, but a decline in birth rates becomes well established. The small-family ideal arises first among "upwardly mobile" couples, particularly in cities, who come to see too many children as a hindrance to taking advantage of the opportunities offered by the expanding industrial economy. The preference for few children gradually diffuses throughout the country, aided by declining rates of infant mortality.
- The *stage of very low or zero population growth* is reached when mortality is low and fertility hovers around replacement level. Fertility could stabilize below replacement level, leading, in the absence of net immigration, to an eventual decline in the absolute size of a country's population. (Replacement level fertility is explained in the next section.)

Relevance for less developed countries

This view of Europe's historical record and the "theory" based on it have shaped much of the recent thinking about the gap between birth and death rates in today's less developed countries (LDCs), such as Mexico (Figure 5). Particularly emphasized are the notions of fertility decline as a more or less automatic reaction to mortality decline and socioeconomic development as the stimulant for both declines. These ideas have been used to argue that organized family planning programs cannot do much to precipitate or accelerate fertility decline in the developing world. Birth rates will begin a general decline, it is held, only when socioeconomic development has reached such a "threshold" of literacy, infant survival, industrialization, and urbanization that the majority of individual couples perceive small families to be to their own advantage. Modern contraceptives are not necessary for this fertility decline to take place, it is alleged, since much of Europe's fertility decline occurred long before the advent of pills, intrauterine devices (IUDs), and sterilization. This argument was summed up in the rallying cry of many Third World government delegations to the 1974 World Population Conference in Bucharest: "Development is the best contraceptive."

Over the long run, the decline in European birth rates did indeed take place against a general background of modernization and falling mortality. However, a recent spate of studies based on new analytical methods and much more detailed evidence now reveals that there were many deviations from the pattern described in the classical demographic transition theory. Thus it is possible that the shift to low fertility in today's LDCs might also occur differently.*

These studies confirm that in England, for example, birth rates did start falling only after considerable urbanization and industrialization had occurred, late in the 19th century. But they also reveal that the decline began about the same time in far less developed Hungary. And the first evidence of fertility decline was in France, a century earlier, when that country's people were overwhelmingly rural, poor, and illiterate, and infant mortality was still very high. This suggests that a well-designed family planning program could reduce birth rates in a preindustrial society before the speculated "threshold" of development is achieved. Even if some socioeconomic development may be necessary to touch off a fertility decline, there is no telling precisely what factors—or com-

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*This new analysis of historical evidence and its implications for population policies in today's LDCs have been summarized by demographers John Knodel and Etienne van de Walle in a recent *Population and Development Review* article[9] and for PRB's next *Population Bulletin*.

bination of factors—make up such a threshold and, conversely, no assurance that development alone will trigger a fertility decline.

The evidence of widespread infant and child abuse turned up by this recent research suggests that large families were not necessarily desired in pretransition Europe—a reason often given for the persistence of high fertility in some LDCs today. Neglect, abuse, and resulting high rates of infant and child mortality may have been one way of adjusting to high fertility rather than vice versa. Similarly in some LDCs today, high infant mortality may in part reflect couples' reactions to unwanted births (and recent research in Latin America points in this direction[10]). It could be that alternative methods of birth control are simply unknown, inaccessible, or considered objectionable.

This was apparently true in pretransition Europe. Of the two available methods other than abortion, it now appears that withdrawal was less well known than has been assumed and associated mainly with extramarital sex. And long-term abstinence required a high degree of self control. Both were also male methods while it was the women who bore the brunt of incessant childbearing and probably wanted fewer children. Wives in developing countries may also be more interested in birth prevention than their husbands, the historical researchers suggest, and thus current family planning programs which "stress female methods, such as the pill, IUD, injections, and tubal ligation, should contribute to an acceleration of fertility decline."[11] In other words, it may not be necessary to wait for infant mortality to fall in a given LDC before women can be expected to accept modern contraception.

That family limitation took hold in Europe and areas of Western culture overseas like English-speaking Canada mainly in just 30 years from 1880 to 1910, despite widely different circumstances, suggests another lesson from the past. Once some couples lead the way, the idea and practice of family planning can diffuse rapidly. Family planning programs which provide both effective means of fertility control and information about them can speed up this innovation-diffusion process. The historical reproductive revolution also seemed to follow cultural and linguistic lines, independently of socioeconomic development. In Europe, ethnic pockets of high fertility, as in Flemish-speaking Belgium, remained long after considerable development had taken place and after fertility had fallen elsewhere. This is true today in the Muslim Central Asian republics of the U.S.S.R. and other societies where women are extremely subordinated and isolated. In such societies, it is suggested, "policies designed to alter the status of women may be more conducive to reduced fertility than either family planning alone or more general development efforts."[12]

In sum, the history of Europe's fertility decline as reexamined does appear relevant for today's developing nations, al-

Peace Corps photo

The large numbers of children in less developed countries hold the potential for vast world population increases in the future (page 14).

though the "classical theory" of demographic transition may now have to be revised. The new studies do not deny that socioeconomic development enhances couples' motivation for smaller families. But they also suggest that "in many cases a greater payoff [in hastening birth rate decline] might well result from concentrating efforts on improving and extending existing family planning programs."[13]

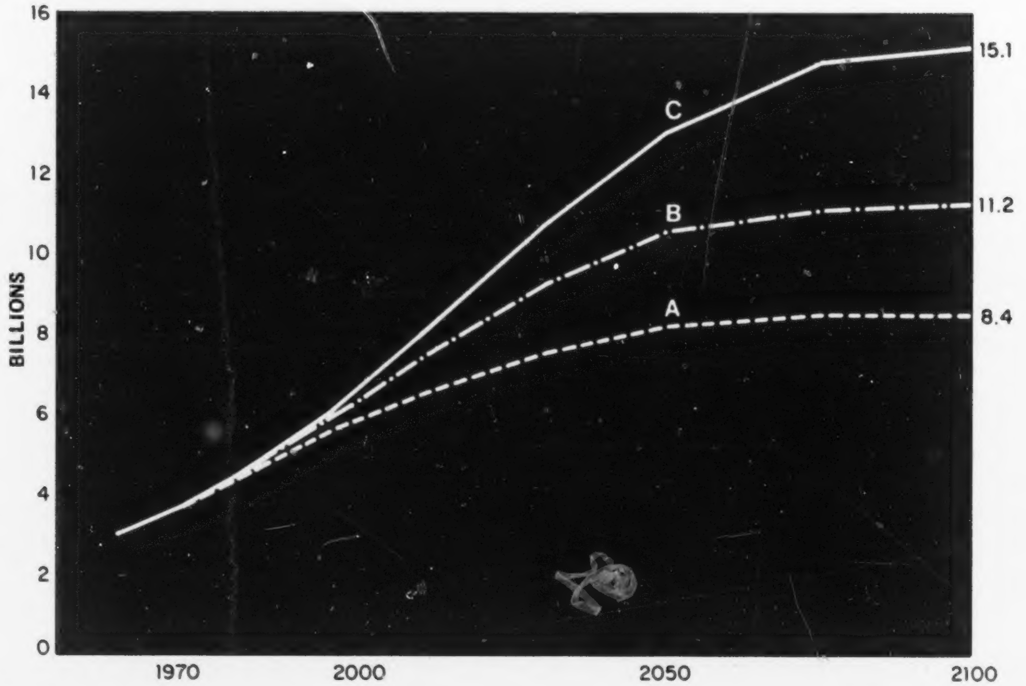
Birth rate reductions in present-day developing countries have often been closely associated with economic and social progress before organized family planning got underway (Singapore, Taiwan, Costa Rica, Hong Kong, and South Korea, for example). However, significant declines have also occurred in relatively backward socioeconomic settings but where political, bureaucratic, and community resources—and womanpower—have been fully mobilized behind family planning (China and Indonesia). On the other hand, Mexico's birth rate remained well above 40 per 1,000 until the mid-1970s, despite rapid economic growth and urbanization and a heavy emphasis on education. A national population program was launched in 1973 and the birth rate has since declined markedly (Figure 5).

In two important respects, the demographic transition in today's developing world is and will be very different from that of Europe. In developing countries, birth rates were often in the high 40s per 1,000 population about 1950-55 at the beginning of their demographic transition and still are that high in Africa today, due in part to early and universal marriage. By contrast, the average in Western Europe in the late 18th century was 30-35 per 1,000. Also, the mortality decline which took a century or more in Western Europe occurred precipitously in most LDCs in about 15 years from the late 1940s to the early 1960s. The result has been population growth rates two or three times what they ever were in Western Europe. Mexico's rate of natural increase reached an explosive 3.5 percent in 1964-66, for example, whereas Sweden's never exceeded 1.2 percent.[14]

The Momentum Factor

The runaway population growth of developing countries in the past three decades is not only adding huge numbers now but also holds the potential for vast population increases in the future and a long delay before annual births come down to annual deaths and the world reaches zero population growth. With high fertility coupled with dramatic declines in mortality, some 40 to 50 percent of developing countries' populations are now composed of children under age 15 in contrast to only 25 percent in developed regions. (Compare the broad-based 1975 population age pyramid of the developing regions in Figure 2, page 6, with the narrow base of that of the developed regions.) Because of this, population would continue to grow for a long time even if it were possible to attain, in the next few decades, an average level of fertility worldwide that would merely replace the parent generation—2.1 to 2.5 children per woman, depending on mortality conditions. The numbers of young people coming into the ages of fertility in developing countries are so much larger than the numbers of people at older ages that, even if couples were to average only enough children to replace themselves, total births would continue to outstrip total deaths until the disproportion in the number of people in the childbearing ages disappears. This could take a century or more in countries where population growth has been very high. The size of the eventual zero growth population would be far larger than at the time fertility dropped to replacement level.

Figure 6. Momentum of World Population Growth



IF THE WORLD ATTAINED REPLACEMENT FERTILITY IN[a]		WORLD POPULATION WOULD THEN STAND AT	AND WORLD POPULATION COULD BE EXPECTED EVENTUALLY TO STABILIZE AT
(A)	2000 – 05	5.9 BILLION (2000)	8.4 BILLION
(B)	2020 – 25	8.4 BILLION (2020)	11.2 BILLION
(C)	2040 – 45	12.0 BILLION (2040)	15.1 BILLION

Source: Tomas Frejka, *The Future of Population Growth: Alternative Paths to Equilibrium*, A Population Council Book (New York: Wiley-Interscience, 1973).

[a] The fertility decline is assumed to begin in all cases with the 1965-70 level. Thus, replacement-level fertility (2.1-2.5 births per woman) by 2000-05, for example, implies a gradual reduction of fertility over a 35-year period.

Figure 6 illustrates the implications for the world of this almost irresistible momentum of growth built into the current youthful age structure of the three-quarters of the world's population living in developing countries. If fertility worldwide were to decline to replacement level by 2000 and stay there—a very optimistic assumption—global population would stop growing only some 60 years later at 8.4 billion, nearly double its 1979 size. If replacement-level fertility is delayed to 2040-45, the ultimate steady-state population would be 15.1 billion, three and a half times that of 1979. (Population Council demographer Tomas Frejka used 1965-70 as the base period in calculating these projections. He expects new calculations, now in preparation, will somewhat reduce the ultimate population totals shown here.)

Table 2 (next page) shows what popu-

Table 2. Projected Timing of Replacement-Level Fertility and Ultimate Population Size: Selected Developing Countries

(Population in millions)

Country	Mid-1977 population	Assumed year when replacement level fertility is reached	Hypothetical size of ultimate stationary population	Year when stationary population is reached
India	632	2020	1,643	2150
Brazil	116	2015	341	2075
Indonesia	134	2020	357	2145
Bangladesh	81	2035	334	2165
Nigeria	79	2040	435	2135
Mexico	63	2015	204	2075
Thailand	44	2005	105	2095
Egypt	38	2010	90	2105

Source: World Bank, *World Development Report 1979* (New York: Oxford University Press, 1979) Table 17.

lation momentum means for eight large developing countries, as recently calculated by the World Bank. Mexico, for example, could reach replacement-level fertility by 2015 if its recent family planning program progress continues, according to the World Bank—down from about 6 children per woman in 1975. If this level held, Mexico's population would take another 60 years to stop growing and would then be more than three times its 1977 size. India, currently the world's second most populous country after China, would take more than a century to reach a stabilized population of 1.6 billion after achieving replacement-level fertility about 2020, according to these calculations. For the world as a whole, the World Bank currently projects replacement-level fertility also about 2020 and an ultimate stationary (non-growing) population of about 9.8 billion, achieved about 70 years later.

Several developed countries now have below-replacement-level fertility, that is, fewer than two births per woman among those now bearing children. If this were to become widespread, growth would stop sooner and the world's population would stabilize at a smaller size. A sustained fertility level below replacement would eventually lead to a decline in the absolute size of a population. China is about to become the first country to adopt such a policy. A new law is being formulated to promote the one-child family with the eventual aim of achieving negative population growth and a reduction in total population size. If successful, this could greatly accelerate the cessation of global population growth at a smaller number than most demographers have hitherto thought possible since China accounts for over a fifth of the world's population.

LDC Birth and Death Rates in Transition

Although reliable data to verify trends are lacking for many less developed countries, most demographers are now convinced that fertility has begun to decline in developing countries as a whole, and in some LDCs the decline is much more rapid than it was in Europe. At the same time, the precipitous decline in LDC death rates that marked the 1950s and early 1960s appears to have slowed.

Parker Mauldin and the late Bernard Berelson, former Population Council researchers, estimated that in the decade from 1965 to 1975 the birth rate of 94 LDCs with 98 percent of the developing world's population declined on average about 13 percent, from about 41 to 35.5 births per 1,000 population.[15] In 28 developing countries containing over two-thirds of the world's population, the decline ranged from 10 to 40 percent. The decline was most marked in Asia and Latin America. Sub-Saharan Africa showed virtually no fertility decline and, with death rates continuing to fall, population growth in Africa had climbed to 2.9 percent about 1977, the highest of any region.

Demographers Amy Ong Tsui and Donald Bogue of the University of Chicago analyzed the record for 1968-75 in a recent *Population Bulletin* and came to essentially the same conclusion as Mauldin and Berelson: the fertility transition has now begun for much of the developing world, most rapidly in such populous Asian countries as China, Indonesia, South Korea, the Philippines, and Thailand.[16] They estimate that the world's total fertility rate or average rate of childbearing fell from 4.6 births per woman in 1968 to 4.1 births in 1975.

In Asia, increasingly delayed marriage appears to have accounted for much of this decline. However, in general, the major cause to date has been reduced fertility among married women, particularly those over age 30. This relates in varying degrees to a fairly steady growth in the proportion of women of childbearing age who use modern contraceptive methods, accelerated in many LDCs by organized family planning programs.

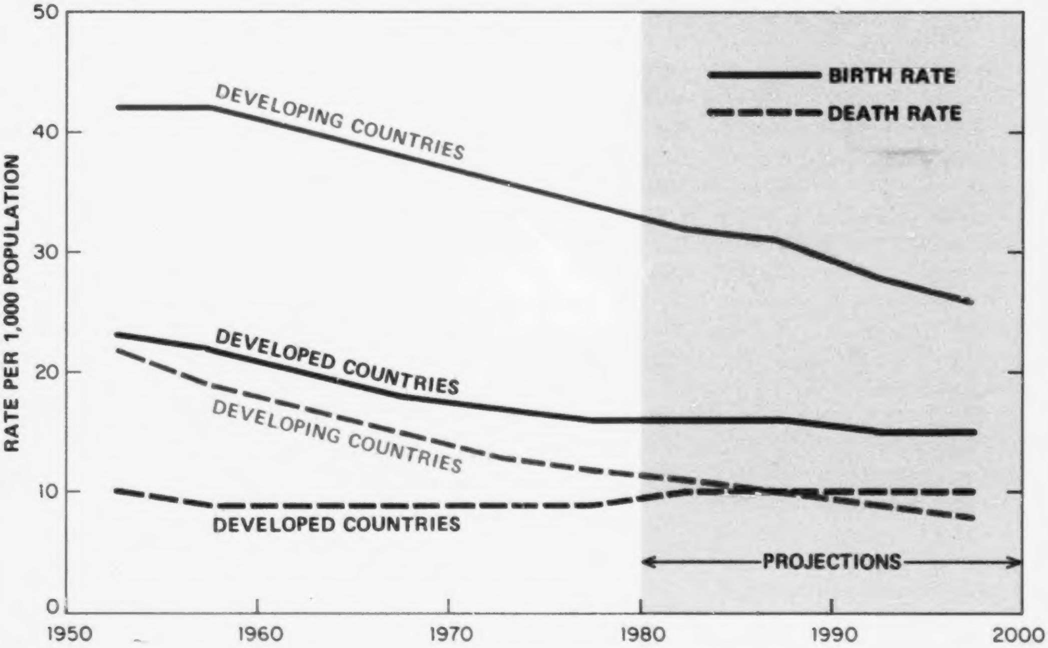
While LDCs have made progress in fertility decline, the spectacular post-World War II progress in reducing mortality has been slowed. In the mid-1950s, life expectancy at birth in LDCs as a whole was increasing annually by 0.7 years. By the early 1970s, the annual gain was down to 0.4 years.[17] The slowdown was most marked in Latin America and in such Asian countries as Sri Lanka, where life expectancy had risen by a spectacular two years annually in the early 1950s, but actually declined between 1967 and 1971. Infant mortality has also risen recently in Sri Lanka and in the swelling cities of Latin America.

It had been expected that life expectancy gains would slow in the developing world once imported medical technologies and health services gained control over such infectious diseases as malaria, smallpox, and tuberculosis. But the slowdown came earlier than anticipated. The United Nations predicted in 1962, for example, that by the early 1980s, life expectancy at birth would stand at 65 years for the "vast majority of the world's peoples."[18] But it is now still in the 40s and low 50s for much of the Third World.

The slowdown which economist Davidson Gwatkin calls "the end of an era" seems related to the rise of dysentery, diarrhea, and pneumonia as leading causes of death, particularly among infants and children. These diseases, often precipitated by malnutrition, are harder to control with modern medicine and physician- and clinic-based health services. Eradicating them takes improved living conditions, especially more and better food and education. For most developing countries, rapid population growth has frustrated this possibility.

The beginnings of fertility decline in many LDCs and the slowdown in mortality decline have combined to stop the steady rise in the world's rate of population growth. The peak was probably passed somewhere in the mid-1960s—a "demographic watershed of historic proportion."[19] The world's birth rate fell below 30 for the first time on record around 1975 and by 1977 was at an unprecedented 28 per 1,000 population.[20] According to the United Nations, the rate of population growth in LDCs as a whole

Figure 7. Birth and Death Rates: Developed and Developing Countries, 1950-1980, and Projections to 2000



Source: United Nations, *World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment*, ST/ESA/SER.R/33 (New York: 1979)

peaked at 2.4 percent in 1960-65, is now down slightly to 2.2 percent, and could narrow a bit more to 1.8 percent at the end of the century (see Figure 7). The total world growth rate is then projected to be 1.5 percent as compared to about 1.7 percent in the late 1970s.

Though encouraging, these trends still add up to huge numbers. As noted, the current 1.7 percent world growth rate is adding some 74 million a year to today's global total of about 4.3 billion. By 2000, 20 years hence, the United Nations projects a total world population of 6.2 billion, with the lowered growth rate of 1.5 percent translating into an annual net increase of about 93 million people. Some 90 percent of the 2 billion increase in the next two decades will take place in the developing world.

Current Population Trends in Developed Countries

The developed world's already low birth rates have sunk even lower in recent years and are now generally in the mid-teens, less than half the birth rates of the developing world (Figure 7). Death rates have also fallen to levels about as low as they can go without breakthroughs in conquering chronic diseases which strike mostly in old age—heart disease, cancer, and stroke. In some countries, death rates are rising as increasing proportions of the population are composed of the elderly among whom death is more likely.

Fertility is at or below replacement level in some 14 developed countries, including the U.S. Indeed, fertility is now as low as, or lower than, mortality in Austria, Belgium, East and West Germany, Luxembourg, Sweden, and the United Kingdom.[21] Overall, however, population is still growing by 0.7 percent annually among the quarter of the world's peoples living in more developed countries, as seen in Figure 7. The U.S. now has below-replacement-level fertility of about 1.8 births per woman, but because of the momentum factor there were 1.4 million more births than deaths in 1978. The U.S. population is thus still growing by about 0.6 percent a year from natural increase. Net legal immigration of about 400,000 annually raises the U.S. population growth rate to 0.8 percent and illegal immigration adds more, although no one knows the exact amount.

Approaching population stabilization and even decreases in absolute numbers have aroused concerns in some developed countries. Eastern European countries, fearing labor shortages in the future, have stepped up pronatalist incentives—child bonuses, and paid leave and supplementary income for working mothers, for instance, and Czechoslovakia, Hungary, and Romania have somewhat tightened their very liberal abortion laws. These measures appear to have had some effect: except for East Germany, birth rates are now in the upper teens in Eastern Europe.

In the U.S., the prospect of a doubling in the elderly proportion of the population (age 65 and over) from 11 percent about 1980 to 22 percent about 2030 when the post-World War II baby boom generation reaches retirement age has aroused concerns about strains on the worker-supported social security system. There will then be only about 3 persons of working age (15-64) for every person of retirement age, in contrast to the current 6 persons aged 15-64 for every retiree.

Developed countries have had and will have a long time to prepare to meet these potential problems presented by current low fertility and resulting changes in population age structure. For developing countries, the very different and massive problems created by their explosive population growth are with them and the whole world now.

Consequences of Rapid Population Growth

The consequences of rapid population growth are evident across the spectrum of human, animal, and plant life. In the less developed world, despite the recent slight slowdown, population is still growing in some countries at rates that could double the numbers of people in just over 20 years. These countries are already hard pressed to supply their current populations with decent living conditions. In countries like the U.S. that have undergone the demographic transition, the problem seems to be of a different order of magnitude. A growth rate of under 1 percent, which would take a century or more to double a country's population, seems less threatening. Yet when put in the context of other global challenges, including continuation of economic progress, balancing world supplies of food, energy, and natural resources, and preservation of the global environment, the growth of the industrialized countries appears nearly as critical.

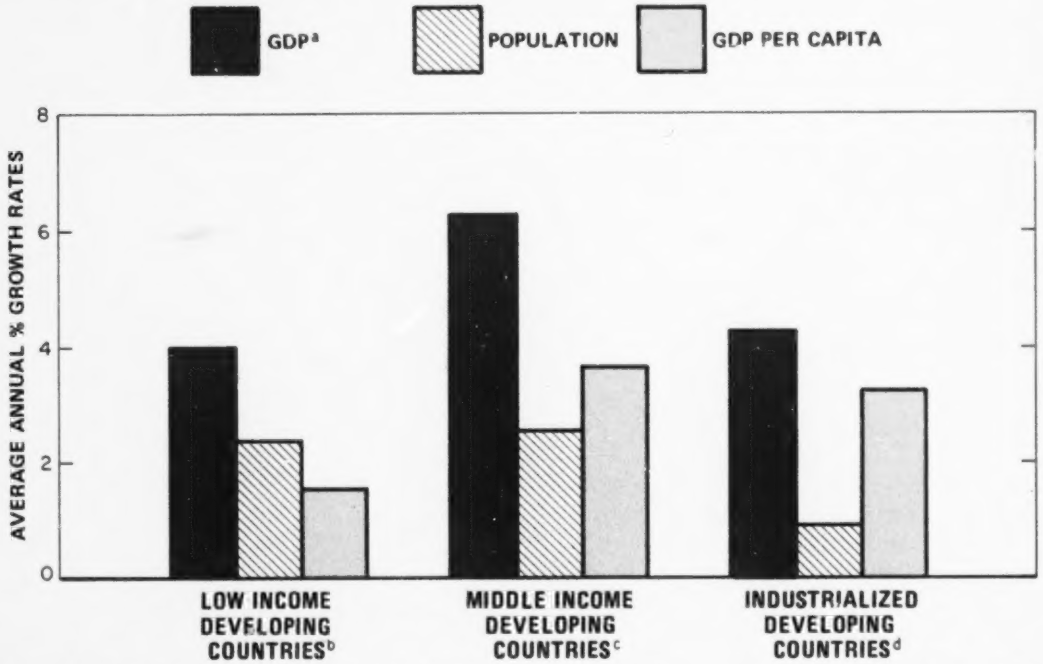
Economic development

Besides exporting the medical and public health revolution to the rest of the world, the Western industrialized nations have also tried, since World War II, to speed economic development and hence raise levels of living in the developing world. Improving living conditions requires that economic growth significantly outpace population growth. As Figure 8 demonstrates, from 1960 to 1976, overall economic growth in low-income developing countries nearly matched that of the industrialized countries, and economic growth in middle-income LDCs was spectacular. But because of much more rapid population growth, the developing world's gain in income *per capita*, and thus levels of living, was much less.

Rapid population growth diverts resources that might otherwise be available for investment in development. As Ambassador Marshall Green, former Coordinator of Population Affairs for the U.S. Department of State, succinctly puts it:

> "When you have a country like Bangladesh, where the population growth every year is over 2 million people, you have to have 400,000 more tons of grain, 700,000 more jobs, 300,000 more dwellings, and 11,000 more schools. How are you ever going to aggregate the capital necessary for development when infrastructure costs are so enormously high?"[22]

Figure 8. Average Annual Growth in Gross Domestic Product, Population, and GDP Per Capita: Developed and Developing Countries, 1960-1976



Source: World Bank, *World Development Report, 1979* (New York: Oxford University Press, 1979) Figure 12. Reproduced with permission.

[a] *Gross domestic product* (GDP) is the value of goods and services produced in a country. *Gross national product* (GNP) adds in the net income received from abroad either from investments or citizens' earnings outside the country.

[b] Per capita GNP of U.S. $300 and below in 1977.

[c] Per capita GNP above $300 in 1977.

[d] Includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, West Germany, Iceland, Ireland, Italy, Japan, Luxembourg, The Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, U.S.

Note: These data exclude countries which the World Bank classifies as *Capital Surplus Oil Exporters* (Kuwait, Libya, Oman, Qatar, Saudi Arabia, and United Arab Emirates) and *Centrally Planned Economies* (Albania, Bulgaria, China, Cuba, Czechoslovakia, East Germany, Hungary, North Korea, Mongolia, Poland, Romania, and the U.S.S.R.)

With up to 70 percent of the population in many LDCs dependent upon agriculture, an important key to economic development is improvement of the agricultural sector. But it is in the agricultural areas of these nations that fertility is usually highest. The result is either out-migration or more and more people on the land, further subdivisions of family holdings, lower output per worker, and a perpetuation of poverty. Similarly, in many developing countries, family size is usually highest among the poor. With many dependents for each working member, resources are spread too thin to allow for the "investments" beyond sheer survival, such as education, which might help these families lift themselves out of poverty.

The discouraging cycle of development handicapped by excessive population growth, and of rapid population growth continuing because the majority of families perceive little chance for economic progress, can be overcome only through a variety of carefully formulated, vigorously pursued measures adapted to each country's needs. But one of the principal requirements in most less developed countries is clearly the earliest possible reduction of high fertility rates.

Employment

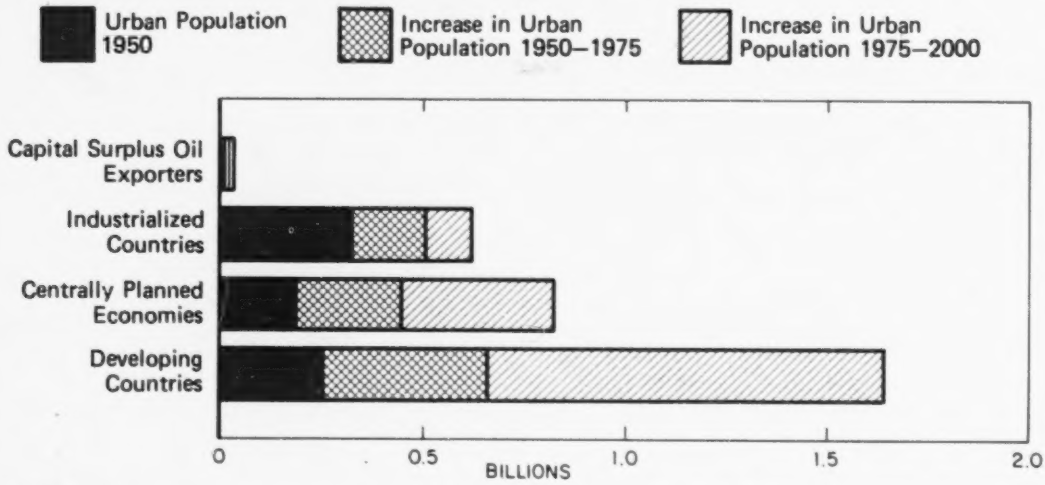
In the two remaining decades of this century, the disheartening effects of past and future population growth in developing countries may be most evident in their exploding labor forces and cities.

Unemployment has become a major problem in the developed world during the 1970s with recurring recessions associated with soaring energy prices coinciding with the coming of age of the post-World War II baby boom generation. But in developing countries the problem is far more daunting and is worsening. The International Labour Office (ILO) estimates that in 1975 there were around 283 million people unemployed or underemployed in the non-Communist developing world—40 percent of the workforce of some 700 million outside China and other Communist countries.[23] About 33 million of these were wholly unemployed; the rest underemployed, that is, seeking additional work either because they worked only a few hours in the day or days in the year or because their income was inadequate to meet their basic needs.

According to the ILO, the high and in some cases rising population growth rates of the late 1960s and early 1970s will translate into an increase in the developing world's labor force from 1.13 billion in 1975 to 1.91 billion in 2000.[24] With these 780 million new workers added to the 283 million currently unemployed or underemployed (outside China), this quarter century will see the need for more than a billion new jobs in the developing world where job-creating development is proceeding all too slowly. Particularly worrisome is the high projected labor force growth—and hence probably also unemployment—among urban youth aged 15 to 24, politically and socially the most volatile of all age groups.

Job shortages have already forced millions of would-be workers to migrate from developing countries. The World Bank estimates that industrialized countries of North and West Europe currently have over 6 million workers from Northern Africa and less developed countries of Southern Europe such as Yugoslavia and Portugal.[25] Leonel Castillo, former Commissioner of the U.S. Immigration and Naturalization Service, has placed the number of illegal migrants now in the U.S. at 3 to 6 million, the majority of them from Mexico.[26] Over the long run, lower fertility and economic progress in developing countries should reduce the supply of excess labor. Meanwhile, the "escape valve" causes social problems for migrant workers and the host countries and complicates international relations. This is nowhere so true as with "undocumented aliens" in the U.S. Some people are also concerned

Figure 9. World Urban Population Estimates and Projections: 1950-2000



Source: World Bank, *World Development Report, 1979* (New York: Oxford University Press, 1979) Figure 10. Reproduced with permission.
Note: For countries included in these four categories, see Figure 8.

that the increasing, if unknown, contribution of illegal immigration to net population growth in the U.S. dims the prospect of this country's reaching zero population growth. In Europe, recruitment of foreign labor has tightened with the economic slowdown since 1973 and several countries have subsidized the return of foreign workers to their native lands.

Urbanization

By the year 2000, over half the world's population is likely to be living in towns and cities, up from 39 percent in 1975. For developing countries, this worldwide phenomenon presents very different prospects from what it did in the past for the now developed world. As the World Bank puts it:

> "Whereas urbanization in the industrialized countries took many decades, permitting a gradual emergence of economic, social and political institutions to deal with the problems of transformation, the process in developing countries is occurring far more rapidly, against a background of higher population growth, lower incomes, and fewer opportunities for international migration."[27]

Enormous numbers of people are involved. Between 1950 and 1975, the urban population of developing countries grew by some 400 million people. Between 1975 and 2000, the increase will be close to one billion (Figure 9).

The problem is aggravated by the concentration of urban dwellers in very large cities. In 1950, only one city of the developing world (Greater Buenos Aires) had a population over 5 million, compared to five such cities in the industrialized countries. By the year 2000, according to World Bank projections, the developing world will have about 40 cities this size and the developed world 12. Eighteen cities in developing countries are expected to have more than 10 million inhabitants, and one at least—Mexico City—may well have three times that number.

Contrary to what is often believed, the flight of job searchers from rural areas is not always the main factor in the developing world's relentless urban growth. In Latin America, for example, where more than half the population already lived in urban areas in 1975, rural-urban migration is expected to slow considerably in the coming decades and the growth in urban dwellers to three-quarters of the region's population in 2000 will be due mainly to natural increase (the excess of births over deaths) within cities. In the low-income countries of Asia, living and working conditions are generally no better in cities than in rural areas, a fact which discourages rural exodus. But this region already has some of the world's largest cities and urban populations: in 1975, for example, the urban population of India was greater than the combined urban populations of Argentina, Brazil, and Mexico.[28]

Whether due to rural-urban migration or natural population increase, it is clear that burgeoning population is putting tremendous pressure on the abilities of LDC cities to cope. In many of these cities, more than half the population lives in slums and squatter settlements; between one-fourth and one-third of the population has no access to safe water supply or facilities for human waste disposal; and people live five or six to a room, acutely aware of the great disparity between the poverty of the majority and the wealth of the urban elite. All this contributes to alienation and frustration on a massive scale.[29]

Public services

In rural and urban areas alike, the populations of many less developed countries are growing faster than educational, health, sanitation, transport, and other public services can be provided.

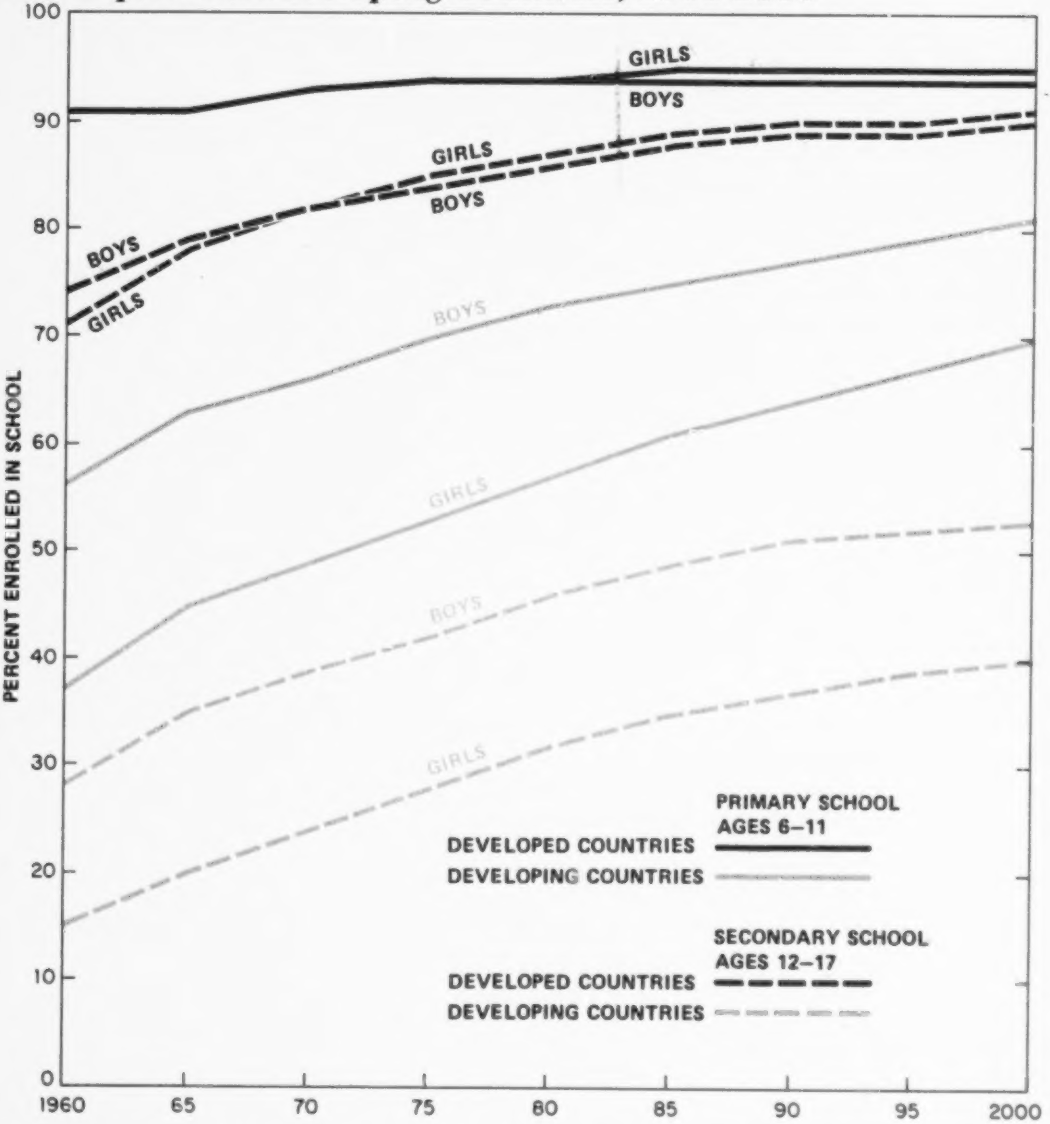
Most LDCs have made heroic efforts to improve educational opportunities, and the proportion of school-age children enrolled in school has indeed been rising. Nevertheless, the gaps in enrollment between developed and developing countries, and between boys and girls in developing countries, remain large and, according to UNESCO, will remain large to the end of the century (Figure 10, page 24). Moreover, despite growing enrollment rates, fast-growing populations of young people mean increases in the absolute numbers of children out of school. UNESCO estimates that there will be 130 million children aged 6-11 out of school in developing countries in 1985, up from 119 million in 1970.[30] Similarly, the *number* of illiterate adults worldwide increased from 700 to 800 million between 1950 and 1975 even though the *proportion* of such adults dropped from 44 to 32 percent during that quarter century.

Housing is a particularly critical problem. In Asia, the backlog of needed housing units in urban areas increased from 22 million dwellings in 1960 to 72 million in 1975; in Asia's rural areas, the need for housing units went from 125 to 219 million in the same 15 years.[31]

Health facilities are on a similar treadmill. Inability to keep up with the demand from growing populations is part of the explanation for the recent slowdown in mortality declines in less developed countries. The World Health Organization estimates that 80 to 90 percent of rural populations in developing countries have no access to health care. The urban poor are scarcely better off. In Sao Paulo, for example, infant mortality has recently risen, malaria and bubonic plague have reappeared, and meningitis reached epidemic proportions in 1974.[32] Experience with community-based health systems in a growing number of countries such as Colombia, Jamaica, and particularly China shows that expanded use of paramedical personnel trained to perform routine health services can help meet some of the need. But unless population growth can be slowed, this approach will still leave vast unsatisfied health requirements.

Though rapid population growth puts pressure on public services, the experience of Sri Lanka demonstrates that special efforts to make such services available to all of a developing country's people can actually help lower that growth. Sri Lanka launched a family planning program in the mid-1960s, but much of the sharp fall in its birth rate

Figure 10. Percent of Boys and Girls Enrolled in School: Developed and Developing Countries, 1960-2000



Source: Magda Cordell McHale and John McHale with Guy F. Streatfeild, *Children in the World* (Washington, D.C.: Population Reference Bureau, 1979) p. 56, based on data supplied by UNESCO Office of Statistics.

Note: Developed countries include all of Europe, U.S.S.R., Japan, U.S., Canada, Australia, New Zealand, Argentina, Chile, Uruguay. Developing countries include all others.

from 33 to 26 per 1,000 between 1965 and 1977 is attributed to rapid improvements in education, health, and nutrition which resulted not from gains in per capita income, which remains at a low $200, but from the country's heavy emphasis on mass-oriented social expenditures.[33]

Food

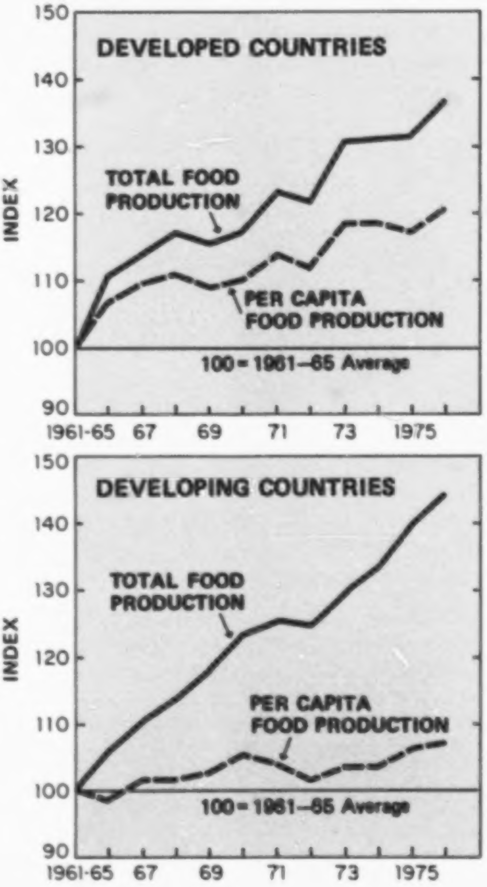
Since World War II, food production worldwide has increased at a slightly faster rate than population. But most of the improvement in food supply *per person* has been in the already well-fed industrialized countries.

From 1961 through 1976, developing countries as a whole improved food production at a faster rate than developed countries, but because of rampant population growth, their per capita food output grew at a much slower pace (Figure 11). The gain in per capita food production averaged a steady 1.4 percent in industrialized countries during this period. In developing countries, by contrast, annual per capita gains were already below 1 percent in the 1960s and nearly vanished in the early 1970s when droughts slashed yields across Asia and Africa. With better weather, expanded irrigation, and other investments, agricultural production has since improved in the developing world, particularly in Asia, but the situation remains precarious. In India, for example, the 20 million tons of grain reserves collected during four years of good harvests are expected to be drawn down heavily following 1979's late and erratic monsoon rains and poor harvest.[34]

Average per capita food intake in the developing world in 1972-74 was about 2,210 calories a day, compared to 3,380 in the industrialized countries. A 1977 U.N. Food and Agriculture Organization (FAO) survey found that in 44 developing countries per capita daily calorie supplies actually declined between 1961-63 and 1972-74.[35]

The developing world's low *average* intake figure fails to reveal the depth of the problem. Their starchy diet, made up mostly of grains and tubers, is less nutritious than the daily fare of developed countries. And the impoverished majority of people within developing countries fail to get as much as the average indicates since the wealthier get more. The FAO estimates, conservatively, that 455 million people in the developing world in 1972-74 were chronically undernourished, that is, failed to get enough food to "lead a full, healthy life." This was up 54 million over 1969-71, "largely because of population growth."[36] Surveys indicate that "up to 50% of all young children in the developing world may be inadequately nourished"—a deprivation likely to lead to lasting physical and mental damage for those

Figure 11. Total and Per Capita Food Production: Developed and Developing Countries, 1961-65 to 1976



Source: Food and Agriculture Organization of the United Nations, *The Fourth World Food Survey*, 1977 (Rome: 1977) Figure 1.

Note: Developed countries include all of Europe, U.S.S.R., Israel, Japan, South Africa, U.S., Canada, Australia, New Zealand. Developing countries include all others.

who survive. Many do not survive. Malnutrition-related deaths among children under age five may run as high as 10 million annually, according to a World Bank estimate.[37]

If the developing world's population continues to grow by 2.1 to 2.2 percent a year, the FAO estimates that food supplies available to them must rise by at least 4 percent annually if the "calorie deficit" is to be made up by 1990. To do this will require either massive imports of food or greatly stepped-up agricultural production. Meeting the deficit through imports, sources of which cannot be assured, will force many of the developing nations deeper into debt and limit their ability to finance other capital costs of development, including expanding food production. And even if the imported food and funds are somehow available, equitable distribution and physical movement of the enormous grain tonnages involved in feeding hundreds of millions of people will present tremendous problems.[38]

For a time during the 1960s and early 1970s, much hope for increasing agricultural production was placed in the use of better cultivation methods and especially use of higher yielding strains of wheat and rice—the "Green Revolution." But when introduced to less developed countries, the Green Revolution has proven to carry with it a host of problems. In the words of Paul and Anne Ehrlich:

> "There are serious obstacles to establishing the new technology among small, poor farmers—who grow most of the food in LDCs and who most need help. These socioeconomic problems and the vulnerability of the high-yield monoculture crops to climate changes, water and fertilizer shortages, and pest outbreaks may render the high yields less dependable than present harvests."[39]

Many observers note that, like the high agriculture yields in the developed world, the Green Revolution "miracle grains" take tremendous amounts of energy for irrigation, fertilizer, and mechanized inputs. As cheap energy becomes less available, particularly oil and natural gas, the possibilities of increasing food production in developing nations will be diminished.[40]

Norman Borlaug, who received the Nobel Prize for Peace in 1970 for his work in developing the miracle grains, claims that "producing more food and fiber and protecting the environment can, at best, be only a holding operation while the population monster is being tamed." In a 1979 address he noted that to feed the 4 billion people who would be added to the world's current 4 billion in the next 40 years if growth were to continue at 1.8 percent a year, global food and fiber production would have to be increased during that 40 years by more than it had increased during the entire 12,000 years since the dawn of agriculture.[41]

Increasing acreage devoted to food production faces similar formidable problems. Most of the world's well-watered arable land is already under cultivation. The potentially tillable land left, mainly in Latin America and Africa, would require huge investments for special care of tropical soil or supplementary water supplies in arid regions. Meanwhile, millions of acres of fertile farmland are lost each year because of the growth of cities, erosion, formation of deserts, salinization, overgrazing, and poor management. The U.N. Environment Programme sees twice as much land being lost to these factors by the end of this century as the amount expected to be brought into agricultural production. The U.S., the world's major grain exporter, currently loses about one million acres of prime farmland each year to urbanization and other uses, according to the Council on Environmental Quality.[42]

Minerals and energy

In the past two decades, much has been written about an inevitable "collision" between finite global resources of minerals and energy and spiraling popula-

World Bank photo by Jaime Martin

Stacking grain in Guatemala. A host of problems have dimmed the Green Revolution's promise for increasing agricultural production in developing countries.

tion growth in developing countries, coupled with high consumption in developed countries.[43] In these circumstances, it is claimed, developing countries as a whole could never hope to catch up with the developed nations' living standards of the 1970s, let alone the levels those nations might attain sometime in the future.

Others have offered a somewhat different view. This was discussed by Resources for the Future researchers Ronald Ridker and Elizabeth Cecelski in the August 1979 *Population Bulletin*, "Resources, Environment, and Population: The Nature of Future Limits."[44] For the near term, they see the problems to be faced as "associated less with physical exhaustion of resources than with their unequal distribution and the transition problems of moving from one resource regime to another in an orderly fashion. . . . Poverty-stricken countries and impoverished groups within countries can only be helped by lifting the barriers to the flow of resources, knowledge, and technical and managerial skills into, and/or people, out of these regions."

For the long term, they believe that "there is no danger that the world will 'run out' of minerals as a whole." Minerals and materials like aluminum, plastic, and glass from "virtually inexhaustible sources" can substitute for less abundant minerals like tin, tungsten, and lead, "provided that sufficient energy is available at reasonable cost, both economic and environmental." As for that energy, Ridker and Cecelski agree, like most observers, that the world's prime sources of energy of the past 25 years—oil and natural gas*—will be essentially exhausted sometime after the turn of the century. In the coming decades, coal, oil from shale and tar sands, and nuclear fission—if its safety problems can be resolved—can play an increasing role. Over the long term, solar energy in its various forms and possibly nuclear fusion can provide sources of renewable or "virtually inexhaustible" energy, they say. These new sources of energy could be expensive, they warn, although the costs can be expected to come down as their development proceeds.

Ridker and Cecelski's analysis is based on a projected stable world population of about 10 billion—a billion below the current U.N. "medium" projection for the early part of the 22nd century. However, they assert that a slowdown in population growth rates is important in buying time with which to find solutions.

A slowdown in economic growth or resource consumption can buy equally valuable time to make adjustments. However, Ridker and Cecelski point out that an economic slowdown would reduce the trained manpower and capital available to work on the world's resource problems. It could also frustrate developing countries' legitimate aspirations for a decent level of living as international markets for their products and capital for investment dry up. This could intensify the dangers of the growing polarization of economic and political relations between developed and developing nations along "North-South" lines.

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*Surprising as it may now seem, it was only between 1955 and 1960 that oil and natural gas, taken together, began to account for more than 50 percent of total world consumption of commercial energy. Coal still accounted for nearly a third of the total in 1975.[45]

Economic growth is likely to be slower in industrial countries in any case in the coming decades, due largely to higher energy prices forced by oil producers and the cost of developing substitutes. This is likely to slow development aid, according to the International Finance Corporation, forcing the developing nations to "look increasingly to their own resources and initiatives."[46] Among those initiatives, stepped-up efforts to speed the fertility decline already begun should have prime priority.

Others see danger for the world's resource supplies in both the high consumption rates and continuing, if much slower, population growth of industrialized nations. In 1972, with just over 5 percent of the world's population, for example, the U.S. consumed 32 percent of the world's commercial energy.[47] Thus, since per capita consumption is so high, even the slow rate of population growth in this country may have as deleterious a long-range effect on the world's available resources as the much higher growth of an equivalent population in low-consumption developing nations.

WHO photo by P. N. Sharma

A meager day's fish catch in India.

Environment

Even more critical for future generations than rising demands for mineral and energy resources may be the growing pressure of population on the global environment.

In recent decades, the earth's vegetation cover (croplands, forests, and grasslands), fisheries, water sources, and atmosphere have undergone a sharply increased rate of depletion and pollution.

A large part of this is again due to high production and consumption lifestyles, coupled with still-growing populations, in industrialized countries. Environmental degradation has also resulted from the desperate efforts of rapidly growing impoverished populations in developing nations to survive. Vast areas of Africa, South and Southeast Asia, the Middle East, and Latin America have been crippled by slash-and-burn agriculture, overcropping, overgrazing, and consequent wind and water erosion. Ever-growing needs for cropland, firewood, and timber have reduced the world's forest coverage from a quarter of the total land surface 25 years ago to one-fifth today and a projected one-sixth in 2000.[48] Deprived of water-holding cover, millions of tons of virtually irreplaceable topsoil have been washed into the sea.

The problem worldwide is evident in:[49]

- The destruction of vegetation, the source of food and oxygen;
- The leveling off of the world's annual fish catch since 1970 despite stepped-up efforts, due largely to overfishing and pollution of spawning beds;

- Overcrowding and impairment of national parks, wildlife preserves, beaches, and other natural recreational areas;
- Destruction of animal and plant wildlife essential to a healthy ecosystem by farming, timbering, urbanization, pesticide and fertilizer poisoning, and hunting;
- An increase in illnesses such as emphysema, stroke, parasitic infections, heart disease, and cancer caused in part by the introduction of new chemicals into the ecosystem by air and water pollution;
- Water shortages due to the massive water requirements of modern agriculture, mining, industry, and consumer living; depletion of underground water supplies; pollution of lakes and rivers; exhaustion of promising water catchment and irrigation sites; and increasing acidity of rain;
- Damaging rainfall and temperature pattern changes brought on by increasing carbon dioxide in the atmosphere from the burning of wood and fossil fuels, dust from urban and agricultural activity, and the thermal effects of waste heat and economic activity.

This environmental loss and damage is occurring in a world of 4 billion people. In 20 years, the number of human consumers and polluters is expected to be around 6 billion and still growing.

Public awareness of environmental deterioration has grown enormously in the past decade, especially in industrialized countries where pollution from automobiles and industry is most obvious. But despite the passage of increasingly stringent antipollution regulations, the U.S. and other industrial countries are moving less rapidly than they might to control their environmentally destructive lifestyles. In the developing countries, where funds for conservation and antipollution measures are scarce and dependence on natural resources for survival is heavy, more determined efforts to slow population growth would be a key contribution to their own and the world's efforts to preserve the environment.

U.S. Bureau of Land Management

Stripmining in Montana.

World Response to the Problem

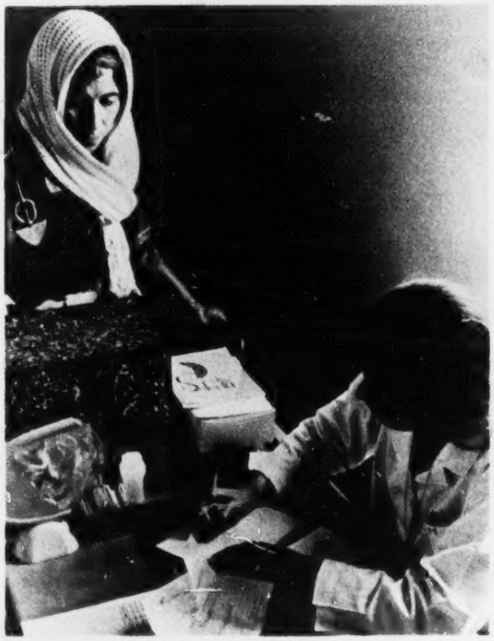
Over the past ten to 15 years, there has been an encouraging increase in world awareness of population problems. Many developing countries have seen the need for urgent action to reduce rapid population growth if their development efforts are not to be greatly impaired or totally frustrated. In 1960, of *all* countries in the world, only India and Pakistan supported organized family planning programs, both for the avowed purpose of reducing birth rates. By 1978, 35 less developed countries—with 77 percent of the developing world's population—had official policies to reduce population growth. Another 30, with 15 percent of LDC population, supported family planning programs for other than demographic reasons. Only 7 percent of the developing world's people lived in the 66 nations that have no family planning activities.[50]

By 1976, according to an International Planned Parenthood Federation (IPPF) survey, $670 million was being spent annually on family planning program support by LDC governments themselves and another $314 million was provided to developing country programs by the U.N. Fund for Population Activities (UNFPA), IPPF, the World Bank, numerous private foundations, and at least nine governments of the developed world.[51] U.S. assistance, administered through the Agency for International Development (AID), provided two-thirds of the $2.1 billion total external assistance over the 1965-78 period, either directly to the countries concerned or indirectly through programs sponsored by private organizations and intermediary agencies such as IPPF and UNFPA.[52]

Family planning "versus" development

Family planning programs in less developed countries vary widely in quality and effectiveness. As former Population Council researchers Mauldin and Berelson put it, these programs "range from vigorous and continuous efforts under skilled management to weak and spotty performance under indifferent administration, on down to no effort at all."[53] How much of the recent fertility decline in LDCs can be attributed to these organized programs? Would birth rates have come down anyway as social and economic development increased couples' motivation to reduce family size, in line with the classical demographic transition theory? These questions have been hotly debated in recent years as the world seeks ways to speed fertility decline in an effort to ward off potentially disastrous overcrowding, deprivation, and disorder.

In the studies mentioned earlier, both published in 1978, Mauldin and Berelson and Tsui and Boque attempted answers. They examined the less developed countries' record in achieving progress in social and economic factors which research suggests are associated with fertility reduction: per capita gross national product, urbanization, life expectancy, literacy, school enrollment, proportions of males or females employed off the farm, and rates of infant survival. For the same time periods, they ranked LDCs according to the strength of their family planning programs from the top (expressed public commitment of political leaders) to the bottom (actual delivery of services). Both studies found that family planning program effort had a significant, independent effect in reducing fertility over and above the effect of socioeconomic progress. However, the key finding appears to be, as Mauldin and Berelson state, that "the two—social setting and program effort—go together most effectively. Countries that rank well on socioeconomic variables *and also* make substantial [family planning] program effort have on average much more fertility decline than do countries that have one or the other, and far more than those with neither."[54]



World Bank photo by William Graham

Family planning in Tunisia.

Before these findings were published, the same questions were hotly debated at the 1974 World Population Conference in Bucharest. As noted, many Third World delegates, pointing to the fertility declines that occurred without benefit of birth control pills or family planning programs as the U.S. and Europe industrialized, argued that "development is the best contraceptive." They put priority on economic aid from richer countries while the U.S. and other delegations from developed countries sought commitments to making family planning services universally available and setting target dates for lower birth rates. In the end, 136 participating governments (excluding only the Holy See) reached consensus on a World Population Plan of Action (WPPA) that, as IPPF Secretary-General Carl Wahren observed in 1979, "put population squarely where it belongs 'within the broader context of internationally adopted strategies for national and international progress.'"[55]

The WPPA advocates a philosophy of "population *and* development." Action is urged to both enhance couples' motivation for small families and provide couples and individuals with the information and means to achieve their desired number and spacing of children, a decision which is guaranteed as a "basic human right."

Motivation for small families

At Bucharest and before, it was recognized that the broad economic and social development thought to be necessary before most couples will opt for small families would be a long time in coming for many less developed countries. But research and experience seemed to show that particular elements of development are especially effective in bringing down birth rates. These were listed in paragraph 32 of the WPPA and include the following:

Reduction of infant and child mortality. When parents can be assured that more of their children will survive to adulthood, they generally have fewer "insurance" births. (The new findings on Europe's demographic history and from Latin America today suggest that the relationship between infant mortality and fertility may be more complicated than once thought.)

Expansion of basic education, especially for girls. Studies in Latin America reveal that women who have completed primary school average about two fewer children than those who have not. For both men and women, education broadens views of life's opportunities and potentialities and reduces resistance to social change, including family planning. It also enhances a girl's chances of employment outside the home that give her alternatives to raising a large family. And parents see children in school as having less immediate economic utility but greater long-term earning capacity; this encourages a smaller, well-educated family norm with children better able to care for parents in their old age. Over the long run, motivation for small families should also be encouraged by incorporating population education into school curricula, as is now being done in many developing nations.

Enhancing the status of women. In addition to increasing women's opportunities for education, most observers agree that enhancing the general status of women socially, economically, and politically could contribute more than any other measure to reduced fertility. When women are accorded esteem for roles other than as mothers or unsalaried house and farm workers, the response is very likely to be smaller families.

More equitable distribution of the benefits of economic growth. Typically in developing countries, the upper 20 percent of the population receives about 55 percent of the national income and the lowest 20 percent about 5 percent.[56] A large proportion of the population remains outside the development process. Experience in Taiwan, South Korea, Sri Lanka, and the state of Kerala in India indicates that economic growth is likely to have the most beneficial effects on fertility where the masses share equitably in that growth through increased income, employment, and access to land and health and education facilities. Large numbers of children are then no longer needed for the little they

World Bank photo by Ray Witlin

Literacy class in Upper Volta. Educating girls may be one of the most effective approaches to reducing fertility in developing countries.

can add to family income while young, or later to support elderly parents. The escape from chronic insecurity and deprivation makes long-term planning and individual control over life's choices, including family size, seem more feasible and acceptable. And with more chances to earn and spend money and time outside the family, parents are likely to find material possessions and lifestyles competing with having numerous children.[57]

Raising the age of marriage. Mauldin and Berelson estimated that 35 to 40 percent of the 1965-75 birth rate decline in the developing countries they studied was accounted for by rising age at marriage, especially of women. This appears to be influenced by more education and employment for women and the "drive to improve socioeconomic status," as in Sri Lanka where the average age at marriage is among the highest in the developing world—28 for men and 24 for women. It may also result from direct intervention as in China where the government urges an "optimal age of marriage" of 28 for men and 25 for women in urban areas, and 25 and 23 in rural areas.

Policy in action

Five years later, the "message of Bucharest"—population *and* development—seems to have been absorbed by developing countries and donors in developed countries alike. But a 1978 joint study by the Organisation for Economic Co-operation and Development (OECD) and the World Bank reports that "it is not proving easy to translate the concept of population *and* development into actual operational programs."[58] On the donor side, the World Bank is trying to introduce population "components" into its projects in other development sectors. AID has been mandated by the U.S. Congress to examine the likely "population impact" of all new development activities and to stress areas, such as education, likely to encourage reduced fertility. But, as in pre-Bucharest years, external aid for population programs remains at just under 2 percent of overall development assistance and, aside from the World Bank and

AID initiatives, there seems to have been little deliberate effort to push particular activities in the other 98 percent of development aid simply because of their presumed effect on reducing fertility.

On the side of the developing countries, reports the OECD/World Bank study, "Despite the Bucharest call for development approaches, family planning remains the prime strategy for implementing population policies." The demand for assistance has risen, far outstripping the $120 million budget of the UNFPA in 1979, for example, but that increased demand has been more than ever for "family planning and related population activities of the pre-Bucharest type."

Recent family planning success stories

At the time of the 1974 Bucharest population conference, family planning in the developing world could boast of successes only in the special city-states of Singapore and Hong Kong, or in such countries as Taiwan and South Korea where fertility had started downward before government programs began and where there was considerable socio-economic development. It was not clear that family planning programs could trigger the transition from high to low birth rates in other countries which did not enjoy similar economic progress. But since then, several family planning program success stories have demonstrated that much can be achieved in circumstances that appear far from ripe ground, as judged by classical demographic transition theory. If these successes can be repeated elsewhere, the prospects for accelerated fertility decline in the coming decades could be much improved.

Chief among these successes is China, with a per capita income of about $410 and a huge agrarian population only 30 years removed from age-old traditions of large families. With over a fifth of the world's population at some 960 million at the end of 1978, what happens in China has enormous bearing on the future size and growth rate of the world's population. According to recent government statistics, China's birth rate at the end of 1978 was down to 20; its death rate was 8; and the rate of natural increase was thus 12 per 1,000, or 1.2 percent.[59] This was equal to the U.S. rate of natural increase in 1964.

The elements of China's success include community-based, free provision of all birth control methods, including sterilization and abortion, by teams of trained, local "barefoot doctors," one of which is always a woman; locally planned and implemented birth quotas; and attempts to integrate women fully into all aspects of society.

On June 18, 1979, Premier Hua Kuofeng declared to the National People's Congress that the government now aims for a natural increase rate of 1 percent in 1979; 0.5 percent by 1985; zero growth by 2000; and, over the long run, a negative growth rate that will reduce the absolute size of the total population. In pursuit of this ambitious goal, a "birth planning law" is now being shaped to encourage the one-child family. Under discussion are proposals to reward one-child couples with substantial child care subsidies until the child reaches 14, priorities in housing and the child's schooling, and—most important—a generous monthly pension upon the parents' retirement, even for rural peasants who now receive no such benefit.

Another success story is found in the densely packed, overwhelmingly rural and poor island of Bali, Indonesia, where two-thirds of women are unschooled. Here, the birth rate fell from 44 per 1,000 at the end of the 1960s to 28 in 1976 when more than half of eligible couples were using modern contraception—up from virtually no use five years earlier before the government family planning program began. Trained village people distribute pills; IUD insertions are readily available; and household heads themselves, through the traditional *banjar* (hamlet) councils, monitor contraceptive use.

In rural, tradition-bound Thailand, the Community-Based Family Planning Services, working side-by-side with an increasingly strong government program, in four and a half years brought low-cost, efficient, pill and condom services, manned by part-time local distributors, to villages containing over 16 million people. In some villages, as many as 80 percent of eligible couples now use modern contraception and the national total fertility rate was down to four and a half children per woman in 1977—two children less than in the mid-1960s.

Bangladesh has a slow-moving administrative system, a per capita income of just $90, and 90 percent of women are illiterate. According to a 1976 national survey, only 14 percent of "ever-married" women had ever used contraception. However, by the end of 1977, after only two years of operation, a nationwide social marketing scheme, launched by Population Services International and working through local shopkeepers, was selling 2 million condoms and over 80,000 cycles of pills *every month* at costs amounting to only $1.40 for every "couple-year of protection."

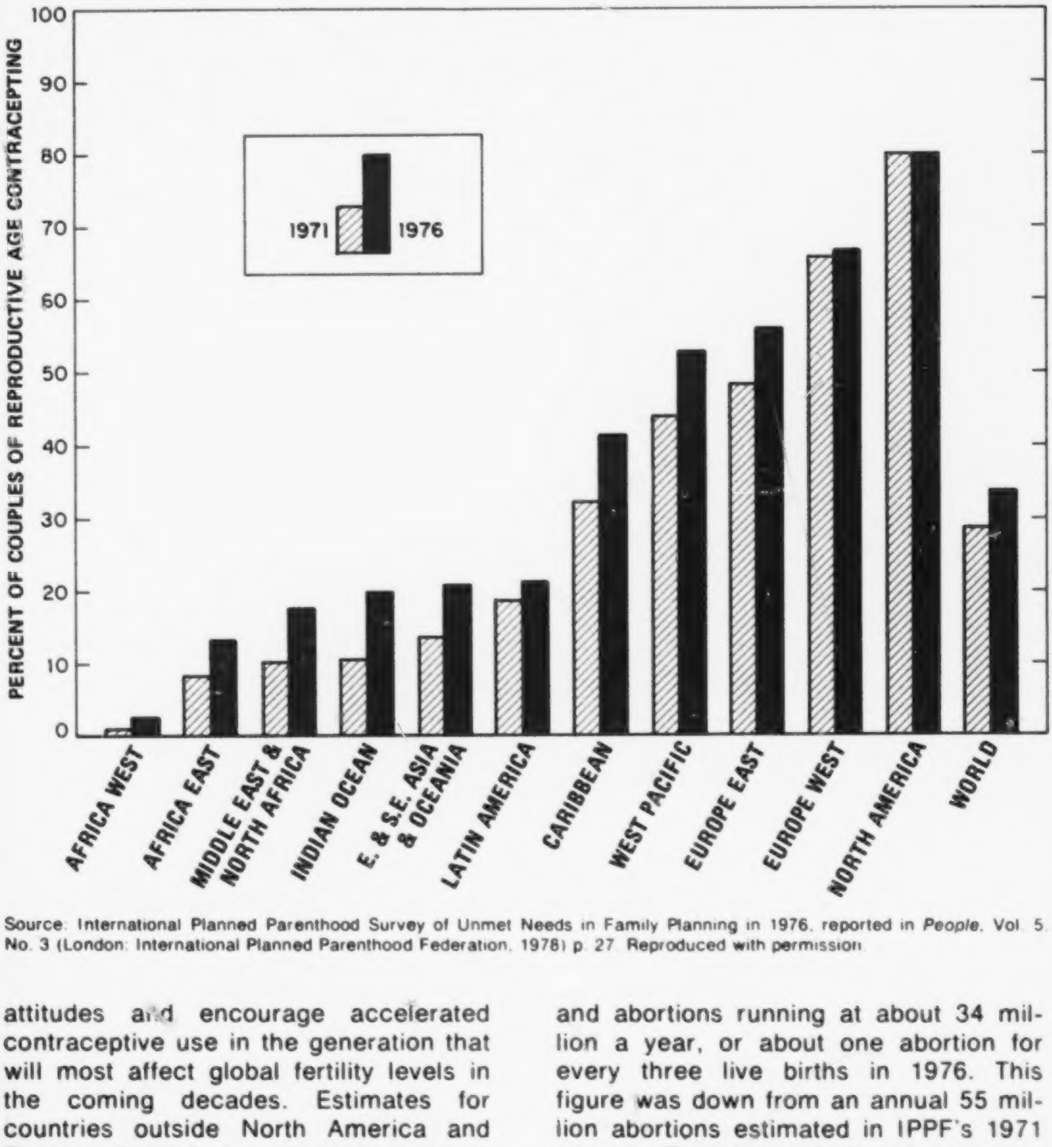
Citing these successes, Malcolm Potts, Executive Director of the International Fertility Research Program, points out their significant factors: access to a full range of effective fertility control methods, including (in China) sterilization and abortion; community involvement; a "realistic use" of paramedics, trained lay people, or local shopkeepers; good management; efforts at self-sufficiency (in Thailand and Bangladesh) with a profit to local distributors and some cash return to the program, even at the very low prices charged to consumers; and, most importantly, resourceful, committed leadership at the top. Potts adds that these successful programs demonstrate that family planning, socioeconomic development, and maternal and child health are "all complementary efforts aimed at improving the quality of human life. Family planning alone can, and sometimes must, make its own direct contribution to health and social progress. But progress will be even more rapid if the fundamental problems of underdevelopment can be tackled from as many sides as the wise management of the limited resources available will allow."[60]

Unmet needs for family planning

Despite specific successes, recent surveys show that family planning still has far to go in the developing world if a massive global population is to be avoided in the future. The International Planned Parenthood Federation (IPPF), in its 1976 Survey of Unmet Needs in Family Planning, found that contraceptive use in over 200 countries taken together had increased only 1 percent a year in the five years since its first such survey in 1971, to reach 35 percent of eligible couples.[61] Contraceptive use was at or below 20 percent in most of the developing world compared to 65 percent and over in developed regions (Figure 12). Moreover, in these five years, the *number* of fecund women worldwide *not* practicing contraception rose from 342 to 361 million, a result of the large numbers of young women entering the childbearing ages. Only half of the world's couples of reproductive age were estimated to have sufficient knowledge of contraception to plan their families. The IPPF report indicated that contraceptive knowledge and practice would have to increase at a much faster pace if the world is to reach even the average family size of just under four children that would be required by 2000 in order to achieve replacement-level fertility about 2045 and a stabilized world population of 15 billion by the year 2100 (see high projection in Figure 6, page 15).

Particularly worrisome was the low level of young people's exposure to education that could change family-size

Figure 12. World and Regional Contraceptive Practice Levels: 1976



Source: International Planned Parenthood Survey of Unmet Needs in Family Planning in 1976, reported in *People*, Vol. 5, No. 3 (London: International Planned Parenthood Federation, 1978) p. 27. Reproduced with permission.

attitudes and encourage accelerated contraceptive use in the generation that will most affect global fertility levels in the coming decades. Estimates for countries outside North America and Europe showed that three-quarters of children under 15 and more than half of youths over 15 still had no access to sex education programs, in school or elsewhere. And in most countries, almost two-thirds of young people had no access to contraceptive methods.

The survey also documented increasing acceptance of sterilization worldwide and abortions running at about 34 million a year, or about one abortion for every three live births in 1976. This figure was down from an annual 55 million abortions estimated in IPPF's 1971 survey. Estimates of illegal abortions came to about the same proportion of the total, despite increasing liberalization of abortion laws in the five years between the surveys.

Findings from the first 15 countries to report in the World Fertility Survey (WFS) indicate that although most women in developing countries now know of

Table 3. Contraceptive Knowledge and Use: World Fertility Survey Findings from 15 Developing Countries, 1974-1977

Country (year of survey)	Percent of ever-married women who have heard of a contraceptive method	Percent of ever-married women who have used a contraceptive method
Asia and Pacific		
Bangladesh (1976)	82	14
Fiji (1974)	100	68
Indonesia (1976)	77	34
Malaysia (1974)	92	46
Nepal (1976)	22	4
Pakistan (1975)	75	10
South Korea (1974)	97	57
Sri Lanka (1975)	91	43
Thailand (1977)	96	45
Latin America		
Colombia (1976)	96	59
Costa Rica (1976)	100	82
Dominican Republic (1975)	97	47
Mexico (1976)	80	45
Panama (1976)	98	73
Peru (1977)	82	49

Source: Sir Maurice Kendall, "The World Fertility Survey: Current Status and Findings," *Population Reports*, Series M, No. 3 (Baltimore: Population Information Program, The Johns Hopkins University, July 1979) Table 13.

Note: The World Fertility Survey is a series of surveys that will eventually cover more than 400,000 women in more than 40 developing countries and 20 developed countries. Funded by the United Nations Fund for Population Activities and the U.S. Agency for International Development, it is being conducted by the International Statistical Institute in collaboration with the United Nations and the International Union for the Scientific Study of Population.

at least one contraceptive method, the gap between knowledge and actual practice remains large (Table 3). The most startling contrasts occurred in Bangladesh and Pakistan. In both countries, over 75 percent of ever-married women surveyed knew of contraception but only 14 and 10 percent, respectively, reported ever having used it. In Nepal, 22 percent knew of contraception but only 4 percent had used it. All three countries have national family planning programs but, at least up to 1976, these government programs had evidently been unsuccessful in effectively delivering services and supplies, and in Nepal, information as well.

The WFS findings point up another gap: between the desire to stop childbearing and use of an effective contraceptive method (pill, IUD, injection, sterilization, or condom). About half of the married women surveyed in the 15 countries reported wanting no more children, but about half of this group were not using modern contraception. Accessibility to family planning services helps close this gap. In Nepal, for example, 95 percent of married women who wanted no more children but did not know an outlet for services were not using effective contraception, compared to only 51 percent of those who knew of an outlet within two hours' travel.

The WFS report agrees that socioeconomic changes indirectly and over the long run affect factors like education, age at marriage, and desired number of children that influence couples' knowledge and use of modern contraception. But, like the successes in China, Indonesia, Thailand, and, to a limited extent, in Bangladesh, the WFS findings suggest that, in the short run, contraceptive knowledge, acceptance, and use can be speeded up in the developing world if services are made widely, easily, and conspicuously available. This should accelerate significantly the decline in birth rates recently begun.

The Outlook

What lies ahead? All are agreed that the world's present growth rate of 1.7 percent, which would double human numbers in just 41 years, cannot continue indefinitely. It is also clear, however, that—barring a nuclear holocaust or massive famine—a much larger population lies ahead for the developing countries and the world as a whole. With close to half of the developing world's population now under age 15, the relentless arithmetic of population momentum will carry waves of population growth into the 21st century even if replacement-level fertility—essentially, an average family of two children—were miraculously to be achieved everywhere tomorrow. Just when Earth's population will stop growing and how large it then will be depends crucially on when that worldwide replacement-level fertility is reached. As World Bank President Robert McNamara recently pointed out: "For every decade of delay in achieving . . . replacement-level fertility—the world's ultimate stabilized population will be about 11 percent greater."[62]

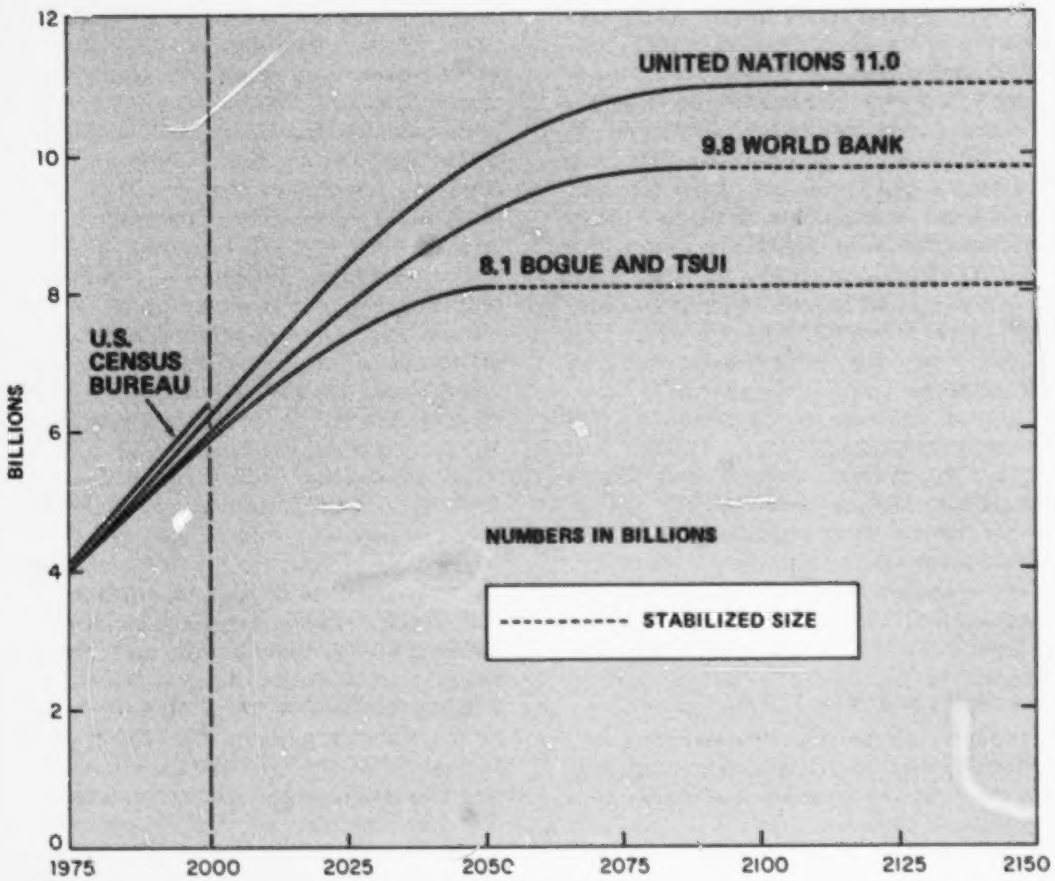
Current "medium" projections for world population in the year 2000, just around the corner, range from a low of 5.9 billion (Bogue and Tsui) to a high of 6.4 billion (U.S. Bureau of the Census)—a difference of "only" half a billion. For further into the future, demographers' opinions vary much more widely as seen in Figure 13 (page 38). Bogue and Tsui predict a rapid slowdown to zero growth and a peak global total population of about 8.1 billion by 2050, provided that family planning programs are pursued vigorously in the developing world and steady gains in social and economic development continue. The most recently published long-range projections of the United Nations put the peak at about 11 billion about a century and a half from now. World Bank estimates fall in between. "If current trends continue," the Bank projects replacement-level fertility for the world as a whole about 2020 and a stabilized population of 9.8 billion some 70 years later.

All these projections depend chiefly on assumptions concerning the pace of fertility decline in developing countries—a pace that could change with unforeseen events or be made to change with sustained will. China, which claims to have cut its rate of natural increase by half (23 to 12 per 1,000 population) in the seven years from 1971 to 1978,[63] could substantially lower the higher projections of eventual world population if its present goal of a nongrowing population by the year 2000 is indeed reached. Other key developing countries are also showing hopeful signs of more rapid than expected fertility decline. Mexico, the world's 11th most populous country at about 68 million in 1979, is now vigorously committed to reducing population growth after a long history of pronatalism. Recent data suggest that its 1975 birth rate of about 40 per 1,000 was reduced to about 35 only four years later, in spite of the enormous number of young people in the childbearing ages.[64] The figures are similar for Indonesia, the world's fifth largest country at about 140 million in 1979.

On the other hand, despite long-standing national family planning programs, almost no fertility decline has been registered in populous Pakistan (80 million in 1979) or Bangladesh (87 million) and their birth rates are still in the mid-40s. India, with about 660 million people, second only to China's some 960 million, has now put off to the mid-1980s a target birth rate of 30 originally hoped for by the late 1970s; contraceptive acceptance rates plummeted following the over-zealous sterilization drive which helped topple Prime Minister Gandhi's government in 1977. Nigeria, Africa's most populous country at 75 million, is not yet convinced that it has a population problem although family planning is supported on health grounds; its high birth rate of 50 may actually be rising. Brazil, the world's sixth most populous country at 119 million, has also supported family planning for health reasons since 1974 but still views a larger population as economically and politically necessary. Though its birth rate may now be down to about 34, Brazil's population is still growing at a high 2.5 percent.[65]

Worldwatch Institute President Lester Brown doubts that a global population as high as 12 billion (an earlier projection of the United Nations) will ever be

Figure 13. Projections of World Population in 2000 and Ultimate Stabilized Size



Sources:

U.S. Census Bureau: U.S. Bureau of the Census, "Illustrative Projections of World Populations to the 21st Century, *Current Population Reports*, Special Studies Series P-23, No. 79, January 1979.

United Nations: United Nations, *Prospects of Population: Methodology and Assumptions*, Population Studies No. 67 (New York: 1979).

World Bank: K. C. Zachariah and My Thi Vu, *Population Projections, 1975, and Long-Term (Stationary Population)*, World Bank, July 1979, unpublished tables.

Bogue and Tsui: Donald J. Bogue and Amy Ong Tsui, Community and Family Study Center, University of Chicago. "Zero World Population Growth?" *The Public Interest* (Spring 1979) pp. 99-113.

Note: The U.S. Census Bureau has not published projections beyond 2000. The World Bank publishes only one series. The other projections shown are medium series (between high and low variants).

reached.[66] He sees crucial biological systems—fisheries, forests, grasslands, and croplands—and oil resources already showing unsupportable strains at the current 4.3 billion. He predicts that further mounting pressures on vital resources, translated into unemployment, lowered per capita income, and inflation, will force restricted childbearing on individual couples and stabilized population policies on governments that do not now have them. To ward off collapse of the earth's major biological systems, Brown urges a "concerted global effort to slam on the demographic brakes" with the aim of halting population growth just short of 6 billion about 2015. This timetable calls for zero population growth in the developed world by 1985—a target already achieved by several industrial countries, as Brown points out. For developing countries, he urges an effort to reduce birth rates to 25 per 1,000 population by 1985, down from the present average of 33, followed by a leveling off for two decades while the current bulge of young people already born moves through their reproductive years, and then a final push to bring birth rates into balance with death rates at a low level by 2015. Brown admits that this "exceedingly ambitious" target would be extremely difficult for African countries in particular where birth rates are now between 40 and 50. But the alternative could be the return of the famines that claimed hundreds of thousands of lives across the southern fringe of the Sahara in the early 1970s. And in achieving the target, Brown observes that "No country would have to reduce its birth rate any more rapidly than Barbados, China, Costa Rica, Indonesia, and Singapore already have."

To speed fertility decline

Efforts heroic enough to meet Brown's timetable are probably unimaginable in the two decades remaining to the 20th century. But clearly birth rate declines must be accelerated now in most LDCs if the world is to avoid an eventual population so massive that the future of humanity and its ecological support system would be jeopardized. The approaches currently being pursued or proposed to speed these declines include both efforts to improve family planning services and "beyond family planning" measures to enhance motivation for smaller families. They can be summed up as follows:[67]

More and improved family planning services. Surveys and experience in Asia and Latin America show that readily available, well advertised services can, in many cases, boost contraceptive practice rates dramatically, even in illiterate, rural, poor populations. A current popular call is for "integrating" family planning services into other development efforts—rural development, nonformal education, and especially health. Here, however, they may get short shrift. More promising is expansion of community-based or commercial distribution of contraceptive supplies. New contraceptive methods which women would use for longer intervals than they now do the pill and the IUD could contribute substantially to fertility declines. A vaginal ring, an improved IUD, and long-lasting implants, expected to be ready for general use in the early 1980s, show such promise. Where available, injections—good for three or six months before needing renewal—have proved popular. If sterilization—now the world's leading contraceptive method with an estimated 90 million couples thus protected[68]—and abortion were made easily and safely available in all developing countries, there could well be a substantial impact on birth rates. But these methods remain officially unacceptable in many areas and among some influential religious groups.

Information and education. Over the long run, population education can change family-size attitudes. In the short run, information about contraception, an integral part of most family planning programs, helps spur contraceptive acceptance. Some governments are going beyond this to emphasize the desirability of the two or three child family, and in China, one child.

Restructured development. This is the "message of Bucharest," that is, to push those elements of development that appear to be most directly related to lowered fertility: reductions in infant mortality, improvements in women's status, better education and nutrition, and generally more equitable distribution of the benefits of development. These are all desirable goals in themselves and indeed are already part of development planning in most LDCs.

Incentives/disincentives. Singapore, a pioneer in this approach, with housing, tax, and maternity policies designed to discourage more than two children per family, has now reduced its fertility to replacement level. Direct payments raised vasectomy acceptances dramatically in India in the early 1970s, but were later abused. Indonesia and other countries are now experimenting with community incentives—offering roads and water supplies, for example, to villages which achieve lowered fertility goals.

Pressures and sanctions. Some observers feel that voluntary family planning, even coupled with measurable gains in levels of living, cannot be expected to reduce LDC birth rates rapidly in the near future because most couples in developing countries, they claim, still *want* large families. Recent World Fertility Survey data do show ever-married women in developing countries reporting that they want one to nearly five more children than the average of about two desired children reported by their counterparts in Hungary and Japan, for example. Even in the U.S., however, desired family size averaged a relatively high 2.7 children among ever-married women aged 15-44 interviewed in the 1976 National Survey of Family Growth (Table 4). People concerned about the apparent gap in developing countries between desired family size and replacement-level fertility argue that closing the gap may take politically organized peer pressure, as in China. In some developing countries, they say, it may take stronger pressures and penalties such as those tried or proposed in India during the sterilization drive of 1976-77, although these backfired. Such measures appear unethical to many people in developed countries, although it is conceded that government restraints on individual freedom in the interest of the common good are accepted in other demographic areas such as age at marriage, international migration, and vaccination. To those who decry government pressure to reduce fertility, the proponents of this approach counter with arguments like

Table 4. Desired Family Size: World Fertility Survey Findings, 1974-1978

Country (year of survey)		Average number of children desired by ever-married women
Africa		
Kenya	(1977-78)	6.8
Asia and Pacific		
Bangladesh	(1976)	4.1
Fiji	(1974)	4.2
Indonesia	(1976)	4.2[a]
Malaysia	(1974)	4.4
Nepal	(1976)	3.9
Pakistan	(1975)	4.3
South Korea	(1974)	3.2
Sri Lanka	(1975)	3.8
Thailand	(1977)	3.7
Latin America		
Colombia	(1976)	4.1
Costa Rica	(1976)	4.7
Dominican Republic	(1975)	4.7
Mexico	(1976)	4.4
Panama	(1976)	4.2
Peru	(1977)	3.8
Developed countries		
Hungary	(1974)	2.0
Japan	(1974)	2.2
United States	(1976)	2.7

Sources: Kenya: Central Bureau of Statistics, *Kenya Fertility Survey: Major Highlights, 1977-78*. (Nairobi: Ministry of Economic Planning and Community Affairs, 1979); Hungary: Hungarian Central Statistical Office, *Main Results of the 1977 Hungarian Fertility, Family Planning, and Birth Control Study, TCS-77* (Budapest, 1978); United States: unpublished data from 1976 National Survey of Family Growth supplied by William F. Pratt, Chief, Family Growth Survey Branch, National Center for Health Statistics. Results from this U.S. survey are to be published within the World Fertility Survey (WFS) series. All other data in this table are from published First Country Reports or Summary Reports of the WFS.

[a] Currently married women.

those of demographer Kingsley Davis at the 1978 hearings of the U.S. House of Representatives Select Committee on Population:

> "It is patently misleading to believe that fertility can be reduced to replacement levels with no restraints whatsoever by way of incentives and/or disincentives for individual behavior. . . . To endorse absolute voluntarism when it comes to having children is to deny the reality of the harsh consequences on human well-being of high rates of population growth and therefore is neither ethical nor humanitarian."[69]

Although the emphasis may vary with individual country situations, all of these approaches are and will doubtless be necessary if fertility is to decline rapidly to replacement level in the coming two or three decades. The only other alternative to staving off an intolerable ultimate global population size is higher death rates and that choice is unacceptable. Migration to industrial countries has eased population pressure for some small and medium-size developing countries—Algeria, Mexico, Morocco, Tunisia, and Turkey, for example. But international migration on the scale that would be required to make a significant difference for countries the size of India and Pakistan is now impossible. India alone adds 13 million to the world's population every year—the same number currently estimated for the refugees that are now straining the entire free world's absorptive capacities.[70]

The growing awareness of the world's population problem over the past ten to 15 years is encouraging as is the recent slowdown in global growth rates. But in absolute numbers the population explosion forecast by Population Reference Bureau founder Guy Irving Burch is with us more relentlessly than ever. In the 50 years since Burch founded the Bureau, world population has more than doubled. If the current growth rate were to continue, the next doubling would take 41 years. In the eight and a half years since "Man's Population Predicament," the predecessor to this *Bulletin*, was published, the earth has added 640 million people—nearly three more United States. The "new look" at the predicament reported here indicates that worldwide action to unravel the predicament is needed more urgently than ever.

Slowing and eventually halting population growth will not alone solve all of humanity's most pressing problems. Lifestyles will also have to change in the rich developed world and among the affluent elite of developing countries if the absolute poverty of what the World Bank estimates to be 800 million human beings in the developing world is to be relieved; all the world's people adequately fed; North-South tensions eased; energy shortages and attendant inflation and unemployment overcome; and the global environment preserved. But rapid population growth shares the roots of these problems with growing consumption rates, and reducing it is essential to their solution.

The world is already overcrowded at 4.3 billion—in both developed and developing countries—and is destined to become much more crowded. We can no longer avoid a world of at least 6 billion and then, probably, some decades later, 8 billion. But the actions we take now could—and must—avert the even greater stresses, poverty, and hunger that would prevail in a world of 10, 11, or more billions.

Photo by Harold M. Lambert

The Age of Discontinuity

By **Rufus E. Miles, Jr.**

Rufus Miles served as PRB's President and Editor from May 1970 to September 1971, after having been a Member and then Chairman of the Board of Trustees since 1957. Capping a long and distinguished career with the federal government, he was the senior administrative official of the Department of Health, Education, and Welfare from 1953 to 1965. From 1966 to 1970 he was director of the Mid-Career Program for federal officials at Princeton University's Woodrow Wilson School of Public and International Affairs. Currently, he is a Senior Fellow at the Woodrow Wilson School.

Long concerned with subjects of demographic consequence, Mr. Miles authored several outstanding Population Bulletins, *including "Population Challenge of the '70s" (February 1970) and "The Future Population of the United States" (February 1971), in addition to the predecessor to this* Bulletin, *"Man's Population Predicament" (April 1971). He is also the author of* Awakening from the American Dream *(Universe, 1976).*

The age in which we live has been properly characterized as "the age of discontinuity." Each year it becomes more apparent that the trends of recent decades—in population, energy consumption, and economic growth—are subject to downward shifts that are more abrupt than any that were thought likely a decade or two ago. Projections based on extrapolations of past trends until the end of the century have often turned out to be much in error, almost always on the high side. Projections for several decades beyond the year 2000 based on similar extrapolations, even with moderate downward adjustments, seem even more likely to require marked reduction as the years go by. There seems little doubt that the world is in for a dramatic set of changes in the most fundamental factors influencing the growth of national societies.

American demographers were confounded after World War II by the amazing increase in fertility that became known as the "baby boom," and by its rather abrupt end and conversion into a "baby bust." Fertility dropped in 16 years to a mere half of what it was in 1957, bringing it down so low that by 1973 American women were no longer replacing themselves. The change was so rapid that the Census Bureau's 1956 "low projections" for 1975 became the "high projections" for 1981. Apart from immigration, the population of the U.S. now seems likely to start declining after the children of the baby boom have completed their families.

Sub-replacement fertility is now becoming the norm in the developed world. Many European countries have lower fertility rates than the U.S. and at least two have already reached the point where their populations are declining. This situation was not foreseen two decades ago when most demographers assumed continuing growth in all countries for at least the rest of the century.

Current medium projections of the United Nations, based on extrapolations of recent trends, put global population at the end of this century at 6.2 billion and ultimate world population (around 2125) at about 11 billion when births and deaths are expected to come into balance. Whether U.N. demographers expect world population to stay at this level after that is not clear. But dramatic changes, already emerging, may cause the United Nations to find itself in the same situation as the Bureau of the Census in the 1960s when it had to issue downward adjustments at frequent intervals because of the rapidly changing mores of American women. This is already foreseeable as a result of the demographic earthquake that seems to be occurring in China.

China's attack on population growth

As highlighted earlier in this *Bulletin*, Deputy Prime Minister Chen Muhua announced in August, 1979, that China had succeeded in reducing its annual rate of natural increase from 2.3 percent in 1971 to 1.2 percent in 1978. Thus, China, although still overwhelmingly rural and agricultural, is moving surprisingly rapidly toward the pattern of low birth and death rates characteristic of industrialized and urbanized nations. Not content with its progress so far, China has decided to mount a strenuous campaign to persuade married couples to limit their families to one child and to reduce population growth to 0.5 percent by 1985 and zero in the year 2000. Such a rapid reduction in the rate of population growth would appear to be unobtainable, but the very magnitude of China's effort to halt its population growth is indicative of a profound and sudden change in the reproductive mores of more than one-fifth of the human race.

The psychological impact of China's remarkable slowdown in population growth may well result in a significant change in official attitudes and policies in many of the developing nations. Until quite recently, the Marxian doctrine that population growth could never be a problem in a well-organized Marxist state was the guiding dogma of China and almost certainly had significant influence on other nations of the developing world. Now that doctrine has been jettisoned by the world's largest nation, presumably on the ground that it has been proven invalid. If it is invalid for China, and if China makes a concerted and continuing effort to reduce fertility to sub-replacement levels, the example can hardly fail to have effect elsewhere.

It can hardly be expected, however, that other developing nations will be able to achieve such rapid birth rate reductions as China has. The levels of education and social discipline in China are higher than in almost all nations that now have high rates of population growth. Moreover, it seems unlikely that even China will long pursue the one-child family goal, since the distortion of the age distribution would become extreme. China would face the unhappy prospect of a very small generation of workers supporting a huge group of oldsters. Nevertheless, China's turnabout in family planning policy now makes it seem likely that the U.N. projection of an ultimate world population of about 11 billion early in the 22nd century will be revised downward in the not distant future.

Photo by Jessie Harris

Boys at the Ming Tombs in Peking. China's drive for a drastic slowdown in population growth could reduce current projections of the world's ultimate stabilized population size.

Does this mean that the prospect of famine, severe malnutrition, and other manifestations of dire poverty will be correspondingly reduced? In some degree, perhaps, but the radically changed energy picture makes it even more urgent that birth rates be sharply reduced in the developing world. The brevity of the era of plentiful and cheap petroleum and natural gas—the second major manifestation of the age of discontinuity—has been gradually sinking into the consciousness of the American people and the rest of the world. The ending of this era will clearly make it much more difficult to lift the living standards of the billions of people in the developing world who are still increasing in number by more than 2 percent a year.

End of the petroleum era

Until the early 1970s, Americans could see no near-term limit to the productivity of their oil or gas wells. The U.S. Geological Survey was estimating ultimate petroleum reserves in the "lower" 48 states of 500-600 billion barrels, enough to last for many decades even assuming a considerable growth in consumption. A lone geologist and geophysicist, Dr. M. King Hubbert, then working for the Shell Oil Company in Houston, Texas, had predicted as early as 1956 that oil "production" (the proper world should be extraction, but it is never used) in the lower 48 states would peak near the end of the 1960s and thereafter begin to decline at an accelerating pace, but nobody paid attention. The peak actually did occur in 1970, but the U.S. Geological Survey was still euphoric about the prospect of great new oil discoveries. It regarded Hubbert's estimate of roughly 165 billion barrels as a gross underestimate of U.S. oil reserves in the lower 48 states. In the nine years since the decline set in, however, Hubbert has become something of a minor prophet and the U.S. Geological Survey has had to reduce its estimates by more than half. (It is worthy of note that Hubbert served as a trustee of the Population Reference Bureau from 1966 to 1972.)

Hubbert based his estimate of U.S. oil reserves (excluding Alaska), and his prediction as to when the peak of production would be reached, on the cassic bell curve. With it, he estimated that the U.S. would consume the middle 80 percent of its total oil deposits of liquid petroleum (outside Alaska) in the 65-year period from 1934 to 1999. He used the same methodology in respect to world oil supplies and concluded, on the basis of somewhat less reliable data, that the middle 80 percent of the world's oil would be consumed in 58 years from 1965 to 2023, with the peak of production being reached between 1990 and 2000.

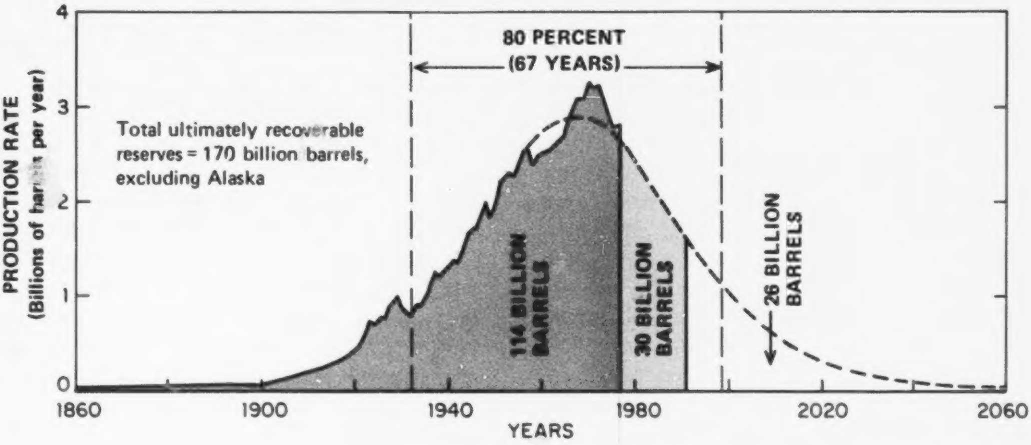
Hubbert has since revised these estimates slightly. For the U.S., based on data to 1979, he increases his estimate of the ultimately recoverable crude oil reserves for the lower 48 U.S. states to 170 billion barrels with the time frame for production of the middle 80 percent extended to 67 years, 1932 to 1999 (Figure 14). Adding in Alaska oil reserves of about 35 billion barrels increases the U.S. total to 215 billion barrels but extends the time frame for only a few more years. For the world as a whole, Hubbert suggests that, for political and other reasons, oil production might stagnate at the current 20 billion barrels per year. If that were to happen, the "middle-80-percent-production" span could be extended to 2056.[71]

In all cases, and even allowing for a fair margin of error, the brevity of the petroleum era is self evident.

One remarkable feature of the petroleum era has been the extraordinary cheapness of energy derived from oil and the consequent speed with which American civilization has structured itself on the assumption that petroleum and its derivatives would always be cheap and plentiful. Even so recently as the beginning of World War II, the man-built features of the U.S. were astonishingly different from what they are today. Cities had no freeways, no circumferential highways, no supermarket shopping centers, few suburbs that were not reachable by mass transit, few commercial airplanes and airports, and an abundance of electric streetcars and railroad passenger trains. Over 43 percent of the people lived in rural areas. In the 39 years since 1940, the country has so completely restructured itself that a person who cannot afford an automobile, or would prefer to live without one, is more of a social cripple in most parts of the U.S. than a paraplegic with a specially fitted automobile. Our society has built itself on the assumption of the universal use of the automobile and the continued availability of cheap gasoline. What will happen to this society when the supply of oil falls further and further

Figure 14. Complete Cycle of U.S. Crude Oil Production: King Hubbert Estimate, 1979

(excluding Alaska)



Source: M. King Hubbert, Consultant, Washington, D.C. 20016, unpublished updated estimate, 1979.

behind the demand? This question will lie at, or close to, the center of American consciousness for the rest of the century.

Hard as it will be for most Americans to learn to readjust to the approaching end of the era of cheap petroleum, its impact on the developing nations will be harder still, and by a substantial margin. They had counted on being able to increase their purchases of oil to help them not only to industrialize but also to increase their agricultural productivity. Those that lack exportable resources or products with which to purchase high-priced oil, and lack the capacity to purchase capital equipment that would enable them to compete in international markets, will find it increasingly difficult to maintain existing levels of living for populations growing at 2 to 3 percent a year, let alone improving their diets and other elements of an increased level of living. The problem is further compounded by the severe maldistribution of wealth and income within many of these countries. The energy problem is clearly making the population problem more acute.

Unfortunately, as the price of energy goes up and as the American consumer finds himself in a tighter and tighter price squeeze, foreign aid to the less fortunate nations seems likely to have low priority within the nation's budget. Cries for a more equitable economic order for the world will probably fall on deaf ears among the voters and the Congress. Conceivably, other international cartels than OPEC (Organization of Petroleum Exporting Countries) might succeed for a time in raising the prices of raw materials or agricultural exports of nations that join together to form a cartel, but the prospects of success seem dim. In these cases, unlike oil, other materials and products can usually be substituted rather rapidly if prices are boosted too high. In the end, hard and unjust as it may seem to the developing nations, most of them are going to have to rely primarily on indigenous solutions to their race between population and resources.

Among the options open to them is the adoption of nationwide programs of education, incentives, and strong encouragement toward small families on a much more concerted basis than those conducted by most of them so far. Failure to proceed in this manner seems likely to result in more severe malnutrition than already exists, and will almost certainly bring on periodic famines in various countries. The oil crisis should bring one nation after another to a realization that there is no escaping the need to bring births and deaths into balance at the earliest possible date. The realization of the human population predicament and effective action to cope with it by the developing world may change reproductive mores more rapidly in the 1980s than most demographers have heretofore thought at all likely.

Within such a world context, Americans are faced with the moral imperative and the practical necessity to reduce rapidly their profligate consumption of the remaining reserves of the world's precious petroleum. A concerted and continuing program of oil conservation will be of more value in the long run to the developing countries of the world than billions of dollars in foreign aid. Simultaneously, it will curb inflation and improve national security. And it may well stave off or reduce the severity of future famines in parts of the developing world.

Barring a nuclear holocaust, the children of the baby boom, who also happen to be the children of the petroleum binge, should live to see the end of the population explosion. They will live to see the extent to which human beings and human societies are able to use their allegedly superior intelligence to adjust to a very different world than one of unending growth. It will be a supreme test of human wisdom. ☐

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Population Bulletin

Europe's Fertility Transition:

New Evidence and Lessons for Today's Developing World

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Abstract—This *Bulletin* describes the methods, findings, and implications of recent research which yields a clearer picture of Europe's historical transition from high to low fertility than was available just a decade ago. New measures have been devised for use in family reconstitution studies based largely on church registers of baptisms, marriages, and burials, and in macro-level studies based on published censuses and vital statistics for such geopolitical units as provinces. Written records left by contemporaries provide a third source of new information. Findings show that Europe's long-term fertility decline resulted from the shift from natural fertility to family limitation within marriage which was previously rare although a substantial portion of births may have been unwanted. High infant and child mortality in the pretransition period may have been partly the result of high fertility rather than the other way round. The start of Europe's fertility decline occurred under a wide variety of socioeconomic and demographic conditions, followed cultural and linguistic lines, and was highly concentrated between 1880 and 1910. Once under way, the increased practice of family limitation and decline in marital fertility were essentially irreversible processes. Similar features can be identified in many less developed countries today, although, where begun, the fertility transition there is occurring far faster than it did in Europe. The authors conclude that, contrary to the currently popular view derived from older impressions of Western Europe's fertility transition that "Development is the best contraceptive," the new evidence suggests that "in many cases a greater payoff [in hastening fertility decline in developing countries] might well result from concentrating efforts on improving and extending existing family planning programs."

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Europe's Fertility Transition:
New Evidence and Lessons for Today's Developing World

By Etienne van de Walle and John Knodel

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Knodel family album

A large German family before the fertility transition.

Europe's Fertility Transition:

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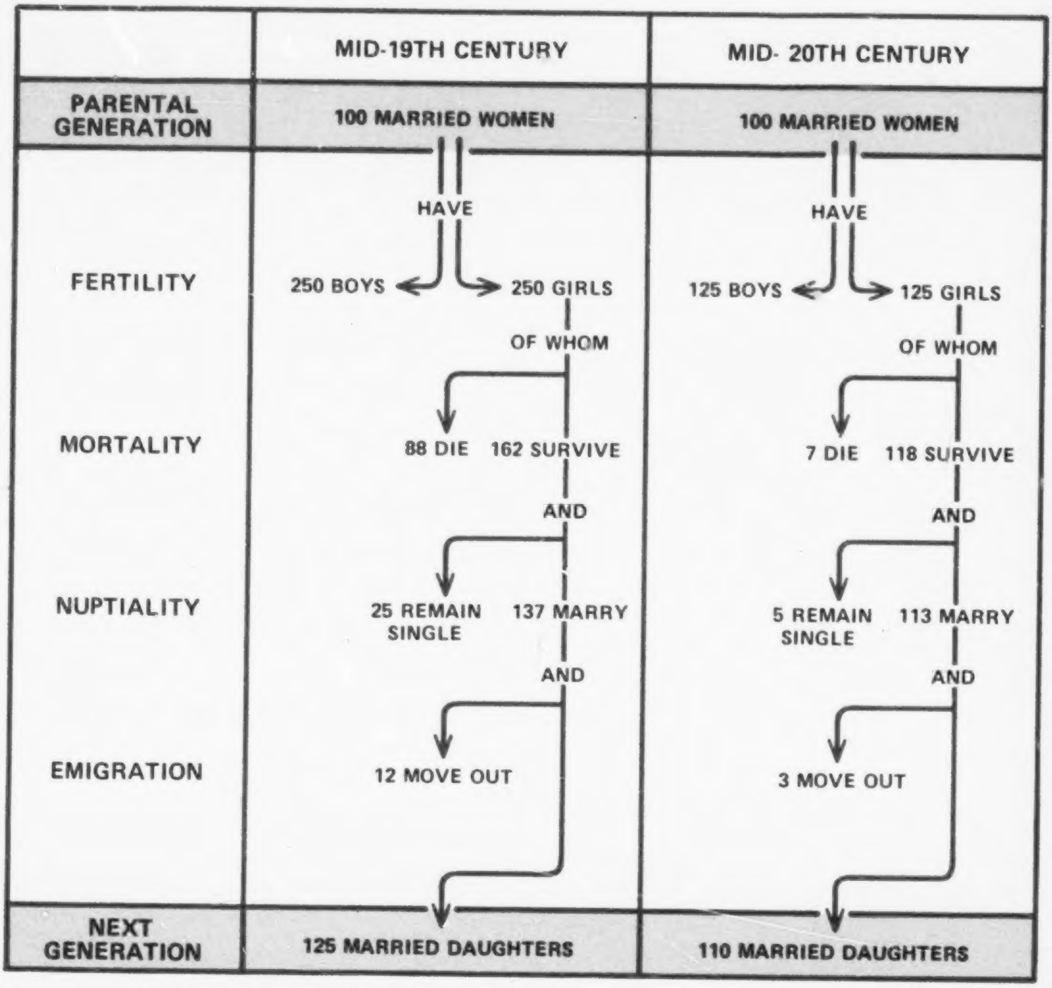
In most countries of the West 100 years ago, women could expect to bear six to eight children, if they married in their early twenties and survived with their husbands until the end of their reproductive years, as is usual today. Four to six of these children would survive to a marriageable age themselves. Actually, the average married woman had considerably fewer births since most women married rather late and some died or were widowed before the end of the childbearing span. And not everyone would marry. In Western European countries, a tenth to a quarter of all women remained single compared to well under a tenth today, on the average. Most of us, if we were to go back a few generations in our genealogies, would find large families, and then progressively smaller ones as we get closer to the present, probably within the past two or three generations. This shift is so recent that many of us can follow it in faded family photographs of the past century. First, there are those of parents surrounded by large broods, ordered by size, with the lastborn in the arms of the mother, and photos of bachelor uncles and spinster aunts; and then, after one or two transitional generations, the snapshots of our own type of families with two or three children.

The change can be illustrated by looking at what would typically have happened to the children born to 100 women married in the middle of the 19th century, in contrast with a corresponding group at mid-20th century. This comparison is presented in Figure 1 (next page) and is intended to be illustrative of Western Europe. The situation would be somewhat different for the U.S. where marriage was not as late in the

Figure 1. Typical Demographic Patterns in Western Europe: Mid-19th and Mid-20th Centuries


MID-19TH CENTURY
MID- 20TH CENTURY
PARENTAL GENERATION
100 MARRIED WOMEN
100 MARRIED WOMEN
HAVE
HAVE
FERTILITY
250 BOYS
250 GIRLS
125 BOYS
125 GIRLS
OF WHOM
OF WHOM
MORTALITY
88 DIE
162 SURVIVE
7 DIE
118 SURVIVE
AND
AND
NUPTIALITY
25 REMAIN SINGLE
137 MARRY
5 REMAIN SINGLE
113 MARRY
AND
AND
EMIGRATION
12 MOVE OUT
3 MOVE OUT
NEXT GENERATION
125 MARRIED DAUGHTERS
110 MARRIED DAUGHTERS

19th century and not quite so many women remained permanently single.

Much of 19th century Europe's high fertility was neutralized by high mortality. The prevailing patterns of delayed marriage and lifetime celibacy assisted in the process. In our illustration, late marriage and premature widowhood account for the fact that 19th century mothers had only five children on the average, well below the potential (left panel, Figure 1). Because of celibacy, 25 of the 162 daughters who survived to the age of childbearing did not contribute to the next generation and emigration accounts for the loss of an additional 12. For the U.S. or other countries which received Europe immigrants, there would have been a net gain of females who might themselves bear children. Comparing the 100 married women at the start with the 125 at the outcome shows that substantial population growth could occur, despite fairly high levels of mortality, non-marriage, and international migration.

The mid-20th century pattern of Western Europe appears on the right side of Figure 1. A substantial decline in fertility makes for fewer children per family but their chances of surviving to the age of childbearing are close to 95 percent. Relatively more of the surviving daughters are likely to marry (and fewer will emigrate). The net result is a 10 percent gain in population over a generation compared to a 25 percent gain a century ago.

This shift from high to low fertility and from high to low mortality is called the demographic transition. It is one of the most influential social transformations of modern times. Because it was accompanied by a wide range of social changes, it would be difficult to imagine the world of today with the families of yesteryears. People who live in modern apartments, benefit from a wide range of consumer goods, have access to the media, and enjoy the benefits (and pay the cost) of advanced medicine, public health, and education do not have large families as a rule. The logic of the small family, so prevalent today, was probably as foreign to our ancestors as their reproductive behavior seems to us.

Seen from the perspective of an entire society, the transformation was characterized by a drastic change in birth and death rates. In the first half of the 19th century, there were two general levels of birth rates in Europe. West of an imaginary line running from the Adriatic to the Baltic Sea, birth rates were under 40 per 1,000 persons per year—the result of late marriage and widespread celibacy—and death rates were in the 20s. East of the line, universal and early marriage made for birth rates above 40 per 1,000—not unlike those in much of Asia and Africa today—while death rates were in the 30s. Now, at the end of the transition, most birth rates are under 15 per 1,000 population in Western Europe and only a little higher in Eastern Europe. And death rates on both sides of the line are down to about 10 per 1,000.

Traditional views of fertility decline

The momentous shift from high to low birth and death rates has intrigued social scientists since it first became evident. Based on what seemed to be the experience in Western Europe, a general "theory of the demographic transition" was developed. This theory holds that fertility decline—the focus of this *Bulletin*—follows only after, and as the result of, a decline in mortality (particularly infant mortality) and an improvement in social and economic conditions or "modernization." This view has been presented to policymakers as a prescription for hastening fertility declines in today's developing countries.

It was pointed out that the shift from high to low birth rates was accompanied by broad developmental changes that transformed the West from a rural-agrarian to an urban-industrial society. Also in the world today, generally speaking, birth rates are low in the developed countries and high in developing countries. Much of Europe's fertility decline took place before modern contraceptives or safe medical abortion were readily available, and thus, it is argued, couples who limited their family size must have done so through withdrawal or abstinence, that is, through methods theoretically available to everyone. If abortion was important—as it evidently was in certain countries by the beginning of the 20th century—it was such a dangerous procedure that women probably resorted to it only in cases of extreme need, and mostly outside of wedlock.

Such impressions of the European experience, together with the differences in fertility apparent today between the developed and developing countries, have been used as evidence to support arguments that organized family planning programs are unlikely to contribute much to the precipitation or acceleration of fertility declines in the developing world. Poor, rural people have large families because they want them, it is claimed, or because they feel many births are needed to compensate for high infant and child mortality. As countries become urbanized and industrialized, people educated, and infant mortality lowered, couples will naturally be motivated to reduce family size. Modern birth control methods are hardly necessary for fertility to decline, it is alleged. "There is ample historical evidence . . . that fertility can be greatly reduced without access to modern contraception. There is no reason to assume that the same thing would not happen anywhere in the contemporary world if that is what people really wanted."[1] This widely accepted argument was summed up in the rallying cry of many developing country delegates to the 1974 World Population Conference in Bucharest: "Development is the best contraceptive."

Since the past is our only laboratory, it is important that lessons for today's developing world drawn from Europe's historical experience should be based on what actually took place. The popular interpretation of Europe's fertility decline has stemmed from a combination of hazy empirical impressions and theoretical preconceptions. Now the record has been examined more closely. Using new sources of information and new analytical methods, historical demographers have recently been able to develop a much more detailed picture of Europe's fertility decline than was available just a decade ago. This new evidence shows that sustained fertility declines in Europe began under a much wider variety of social, economic, and demographic conditions than was previously thought and seemed to follow cultural and linguistic lines; that they were remarkably concentrated as to the time when they started—mostly between about 1880 and 1910; and were irreversible processes once under way. It also shows that large families were not necessarily desired in pretransition Europe; that high infant and child mortality may have actually been partly the result of high fertility rather than the other way round; and that the available fertility control methods—withdrawal, abstinence, and abortion—may not have been used because they were unthinkable for married couples, ineffective, or even simply unknown.

We open this *Bulletin* with a description of the new sources of information and of the refined concepts and measures developed during the recent research and the new picture they reveal of Europe's fertility transition. The evidence is interpreted and we then attempt to draw more accurate lessons from the historical experience for policy in today's developing countries—in many of which the fertility transition has now begun.

Most of the evidence presented here is based on the European (and especially Western European) experience. Historical studies are also emerging for North America, Japan, and other now developed areas, but the research for Europe is more extensive and we are more familiar with it. We also deal mainly with the fertility of married couples. This leaves out of account the important difference between Western Europe's historical marriage patterns and those in developing countries today, as well as non-Western European countries in the past. Western European populations during at least the 17th through the 19th centuries tended to marry later and higher proportions remained permanently single than was true in the U.S. or Eastern Europe at the time, and certainly by comparison with most developing-world populations today. This kept birth rates in preindustrial Western Europe below the levels still typical in many developing countries. Although this adds somewhat to the problems of extrapolating from Europe's historical experience to the current situation in the developing world, we feel the particular lessons we draw remain nonetheless applicable.

New Information Sources

The West has been a record-keeping civilization, particularly with respect to matters related to population. Thus it is possible to study today the changes in human behavior which touched off the fertility transition a century or two in the past. Two quite different types of demographic studies, based in turn on different sources of data, have been largely responsible for the recent expansion in our knowledge of historical trends.

Macro-level studies

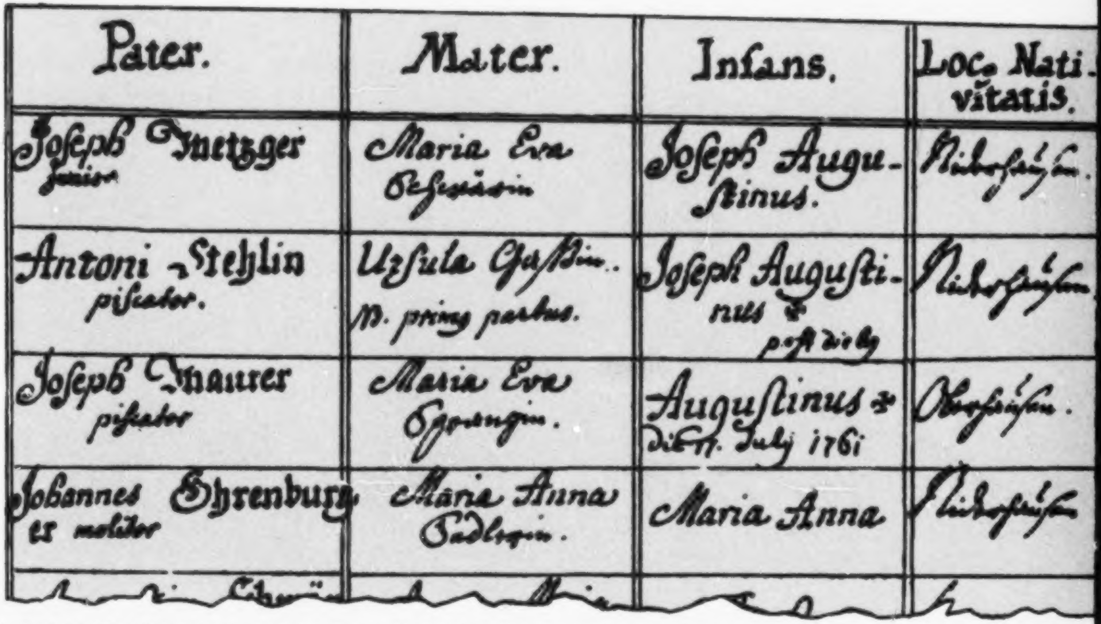
The first kind of study is based on conventional demographic sources, the published censuses and reports on births and deaths issued regularly by national and state statistical offices. Since these reports refer to whole populations of administratively defined geopolitical units such as nations or provinces, studies based on them are labeled macro-level. Among the best known of such studies is the European Fertility Project undertaken by staff and associates of the Office of Population Research at Princeton University under the direction of Professor Ansley Coale. Its aim has been to study the long-term decline in fertility since its beginning a century or more ago in the 700 province-size administrative units of Europe. As a result, considerable information has been unearthed on demographic trends at the provincial level and on the general socioeconomic context in which they occurred.[2]

Censuses have been around for a long time in some Western countries. The oldest to survive for an entire state, a *catasto* of Tuscany, dates back to 1427.[3] New France (present-day Quebec) was the first country to conduct successive national censuses, beginning in 1665.[4] In the U.S., a national census first took place in 1790 and has been repeated at ten-year intervals ever since. However, it was really not until the latter half of the 19th century that most Western countries instituted systematic enumerations of their entire populations and published the results in sufficient detail to be of value for demographic research. Similarly, "civil" registration of births and deaths was not entirely absent in earlier centuries, but did not become systematic in most Western countries until the 19th century. Fortunately, this time limitation on the data available for macro-level studies of the demographic transition is less of a problem that it might at first seem, since in many Western countries the sustained decline in fertility also did not begin until the end of the 19th century.

Micro-level studies

Although macro-level studies have advanced our knowledge of the West's fertility transition, they can shed little light on the situation prior to or at the very early stages of the fertility decline, particularly in areas where the decline began unusually early. Moreover, a number of questions related to the fertility transition can best be addressed with data on individuals rather than on aggregate populations as is the case with published census and vital statistics reports. Fortunately, census lists of names and vital registration records can often still be used individually. And most Western nations possess another valuable source of demographic data, the local parish registers of baptisms, weddings, and burials kept by Catholic and Protestant clergymen, which often extend in continuous series as far back as the 17th century and even the 16th century in some cases. Parish and civil registers have served as the basic data sources for micro-level "family reconstitution" studies which have now extended our knowledge of reproductive behavior back to long before the general

Figure 2. Parish Baptismal Register: Germany, 1760



Pater.	Mater.	Infans.	Loc. Nativitatis.
Joseph Metzger junior	Maria Eva [illegible]	Joseph Augustinus.	Niderhausen.
Antoni Stehlin piscator.	Ursula [illegible]. n. primus partus.	Joseph Augustinus + post dies	Niderhausen
Joseph Maurer piscator	Maria Eva [illegible].	Augustinus + die 11. Julij 1761	Oberhausen.
Johannes Ehrenburger molitor	Maria Anna Sadlerin.	Maria Anna	Niderhausen

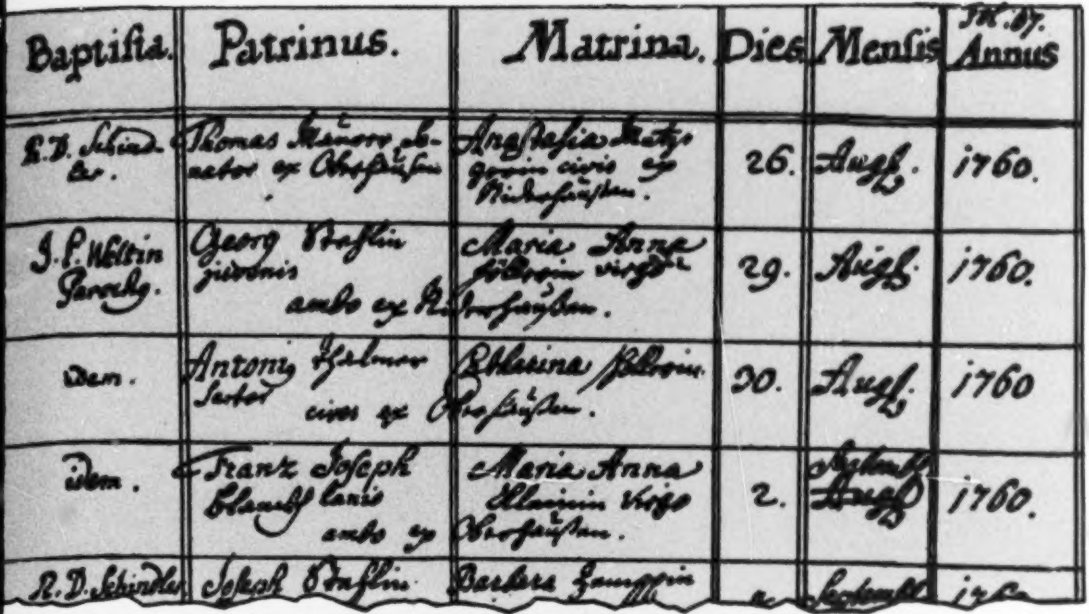
A page section from the baptismal register of 1760 for the parishes of Ober- and Niederhausen in Southwest Germany. The Latin column headings indicate, from left to right, names of the father, mother, and infant, place of birth, the priest who performed the baptism, godfather, godmother, and day, month, and year of the baptism. All entries are in Latin and handwritten in old style German.

sustained decline in fertility. Another source of data for such studies are existing geneaologies of sub-groups, particularly social elites, often compiled in turn from parish registers.

Unlike census and civil registration reports, parish registers are typically unpublished and available only in handwritten form at the local church. Although intended to record baptisms, weddings, and burials for ecclesiastical purposes, they serve as excellent records of births, marriages, and deaths. In some cases, the baptismal registers record even stillborn infants or those who died too soon for baptism. An example of an unusually good baptismal register is shown in Figure 2.

Because parish registers refer to identifiable individuals, it is possible to apply to them the technique of family reconstitution which links the birth, marriage, and death dates of each married couple and their children into a chronology of vital events. (See Table 1 for an example of a typical reconstituted family history.) This greatly expands the scope for research since many important demographic variables, such as birth intervals, family size, people's age at marriage, age of mother at each birth, infant mortality, and marital fertility can be readily calculated from such data.

Micro-level family reconstitution is tedious and time-consuming. Nevertheless, since the technique and the methodology to analyze the resultant data were introduced by French demographers just two decades ago, scholars elsewhere have been quick to follow their lead. By now, a large number of such studies are available for many Western countries, although they cover, even in France, only a miniscule proportion of the population, usually in villages. Rather like sample surveys today which



Baptiſta.	Patrinus.	Matrina.	Dies	Menſis	Annus
R.D. Schind-ler.	Thomas [illegible] ex Oberhausen	Anastasia [illegible] civis ex Niederhausen.	26.	Aug.	1760.
J.P. Weltin [illegible].	Georg Stehlin juvenis ambo ex	Maria Anna [illegible] virgo Niederhausen.	29.	Aug.	1760.
idem.	Antoni [illegible] Sartor cives ex	[illegible] Oberhausen.	30.	Aug.	1760
idem.	Franz Joseph [illegible] ambo ex	Maria Anna [illegible] virgo Oberhausen.	2.	[illegible] Aug.	1760.
R.D. Schindler	Joseph Stehlin	Barbara [illegible]	[illegible]	[illegible]	[illegible]

Source: Albert Köbele and Margarette Kirner, *Ortssipenbuch Rheinhausen:* Selbstverlag des Herausgebers, Grafenhausen, 1975.

ask individual respondents about desired family size and their knowledge, attitudes toward, and practice of contraception, family reconstitution studies can shed light on individual motivations for and use of fertility control which is unavailable from the aggregate statistics on "achieved" fertility drawn from public records. With the help of various indirect techniques, described in the next section, family reconstitution data have revealed a surprising amount about behavior and contraceptive practice in years gone by. Historical demographer Peter Laslett comments:

> "It is an extraordinary thing that we can investigate these, the most intimate, doings of our predecessors and discuss them with some confidence, whilst many of their more public actions and attributes are still mysterious and will probably remain so. When we analyse what happened between man and woman lying together in the little parlours of

Table 1. Reconstituted Family History: Germany, 18th Century

Married 24/9/1759
Antoni Stehlin, Fisherman
born 22/6/1730, died 17/11/1784
and
Ursula Gass
born 20/10/1726, died 10/11/1770

Children

1. Joseph Augustinus, born 29/8/1760, died 29/8/1760
2. Joseph, born 4/4/1762, died 16/8/1770
3. Anna Maria, born 10/2/1764, died 10/5/1776
4. Elizabeth, born 18/11/1766, married 28/2/1791, died 6/1/1814

A reconstituted family history from the parish of Niederhausen. The firstborn child is the second entry in the baptismal register page section shown in Figure 2.

Source: Köbele and Kirner (see Figure 2) their cottages, for the parlour was the bedroom before the ordinary man's house acquired an upstairs, we are in fact observing the purchase over what they allowed themselves to do of a whole social system."[5]

Contemporaries' views

In addition to the contributions made by studies at the macro level and micro level, both of which provide extensive quantitative evidence, our understanding of reproductive behavior in the past is also being increased by a third, very different, group of studies that are largely qualitative in nature. These studies stem more out of the tradition of social history than of demography and are often based on literary evidence, including letters and novels of the time. They also draw on reports by trained, contemporary observers—19th century statisticans interpreting their data in the introductions to official publications, for example, or county and small-town doctors reporting on their patients and striking local health conditions. Taken with appropriate caution, such sources can tell much about knowledge of birth control and attitudes toward reproduction and children in the past and help place the newly emerging quantitative findings in their social, psychological, and cultural context.

Refined Concepts, New Measures

In their study of the historical decline in Western fertility, researchers have refined the conceptualization of the basic demographic processes involved and developed new ways to measure them on the basis of the available data. These refined concepts and new measures are an important contribution of the increased research effort of the past two decades and, when combined with the substantive findings, add considerably to our understanding of the behavior changes that underlie the fertility transition.

Natural fertility and family limitation

One of the most fundamental distinctions to emerge is that between natural fertility and family limitation. Introduced by French demographer Louis Henry about two decades ago,[6] the concept of natural fertility refers to situations where couples do not attempt to terminate childbearing before the end of the biological reproductive span. In other words, couples do not aim for a desired family size and thus make no effort not to exceed a certain number once it is reached. Indeed, under conditions of natural fertility, the very idea of wanting two, three, or any specific number of children may be quite foreign. As we shall see, natural fertility is characteristic of most populations prior to the long-term decline of fertility.

Family limitation refers to the opposite situation where couples make a deliberate effort to terminate childbearing once they have reached some particular number of children which they feel is sufficient, whatever that number may be. It is important to note that family limitation is not synonymous with "birth control." Family limitation depends on the number of children already born and refers specifically to behavior designed to stop childbearing altogether. The term birth control, on the other hand, encompasses both behavior intended to stop births and deliberate attempts to space births, and may also apply to behavior outside of the family context, that is, in illegitimate relations. Birth spacing is not inconsistent with family limitation. However, situations where couples deliberately attempt to space births but are unconcerned with the ultimate number of children (as is common in Sub-Saharan Africa today) are classified as natural fertility rather than family limitation. This distinction is useful because the techniques that have been developed to study historical data can detect stopping behavior but not deliberate birth spacing. The distinction is also theoretically important since it appears that it was the introduction and spread of stopping behavior (and not spacing) that was the key feature in the onset of the fertility transition. In brief, the long-term decline of fertility resulted from the shift from natural fertility to family limitation.

Where natural fertility prevails, couples continue childbearing until they are physiologically unable to have more children. This usually depends on the wife since men are able to father children to considerably older ages than those at which women become incapable of conceiving and giving birth. With no controls on fertility, the age at which women bear their last child in populations that are still in the pre-fertility-decline stage is quite late. This is demonstrated in the results from the family reconstitution studies summarized in Table 2 for couples married before the onset of the fertility transition. The age at which these women bore their last child is remarkably similar across these rather diverse regions of France and Germany, and averaged close to 40. While it is not unknown for women to bear children in their late forties, an *average* age of around 40 seems a reasonable approximation of the maximum age at which any sizable population of women could continue childbearing. Women's average age at menopause is probably closer to 50 but medical and biostatistical evidence indicates that the ability to conceive and bear a live child declines substantially prior to menopause.[7]

Because the average age of women at the time of their last birth varies so little in natural fertility populations, the age at which a woman starts childbearing becomes a crucial determinant of the number of children she will eventually have. Women who marry early and begin childbearing soon after marriage will bear children over a longer period than those who marry later. The importance of age at marriage in determining final family size in natural fertility populations is clearly illustrated in Figure 3 (next page), based on family reconstitution studies for ten German villages and a small town in France. Of course, relatively high infant and child mortality took their toll, reducing the number of children who were born to considerably fewer who survived. But, as the data for the German villages indicate, the relationship between the average number of surviving children and the mother's age at marriage is just as strong as that between age at marriage and total number of births.

Table 2. Wife's Average Age at Last Birth in Pretransition Societies

(Family reconstitution studies of French and German villages)

Location	Number of studies/ villages[a]	Wife's average age at last birth[b]
French couples married in the 17th and 18th centuries		
South and central France	4	39.3
Paris region and north France	4	40.4
Northwest France	7	40.4
Northeast France	3	39.8
German couples married before 1850		
Southwest Germany	5	39.9
Bavaria	3	40.6
Hesse	4	40.7
East Friesland	2	39.6

Sources: Daniel S. Smith, "A Homeostatic Demographic Regime: Patterns in West European Reconstitution Studies," in Ronald D. Lee (Ed.), *Population Patterns in the Past* (New York: Academic Press, 1977); John Knodel, "Natural Fertility in Pre-industrial Germany," *Population Studies*, Vol. 31, No. 3 (November 1978) pp. 481-510, and previously unpublished results from research by Knodel.

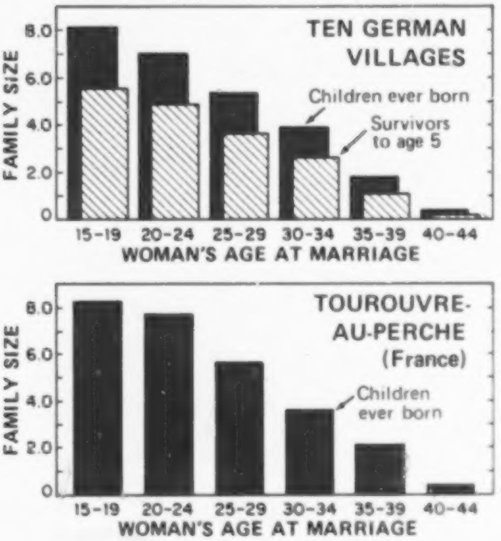
[a] For France, the number of studies, some of which refer to more than one village; for Germany, the number of villages.

[b] Unweighted averages.

Although couples in natural fertility settings apparently never deliberately

Figure 3. Family Size by Woman's Age at Marriage in Pretransition Europe

(Children ever born and survivors to age 5 for couples married before 1850 in ten German villages; children ever born to couples married 1665-1770, Tourouvre-au-Perche, France)



Source: Knodel, 1978 (see Table 2); and Hubert Charbonneau, *Tourouvre-au-Perche aux XVIIe et XVIIIe siècles*, Institut National d'Études Demographiques Cahier No. 55 (Paris: Presses Universitaires de France, 1970).

try to stop having children, there is a surprisingly wide variation in the level of fertility that characterizes these populations. Indeed, the striking variation in natural fertility levels is one of the most important findings of the recent research in historical demography. Table 3 illustrates this for different parts of Germany prior to the beginning of the transition. To make the comparison, we use the total marital fertility rate which represents the total number of births a woman would have if she married at exact age 20, survived to age 50 with her husband, and continued bearing children until that age at the age-specific fertility rates that were actually observed for the particular villages. In the three Bavarian villages, such a woman would have averaged over two more births than her counterpart in the two East Friesland villages. Variations in the levels of natural fertility revealed by other family reconstitution studies are even more extreme than this.

Several reasons could account for these differences, but it is important to recall that deliberate attempts to limit family size are not among them. Factors that can influence the interval between births and thus the level of fertility, but which are generally not dependent on the number of children already born, include variations in the frequency and duration of breastfeeding, periods of separation due to seasonal migration of one of the spouses, variations in the frequency of intercourse, customs prohibiting resumption of intercourse for some period following a birth, and nutritional levels of the population. Of these, breastfeeding patterns are most important.[8] Breastfeeding tends to delay the resumption of ovulation after a woman gives birth, thus increasing the length of the interval between a birth and the next

Table 3. Overall Marital Fertility in Natural Fertility Societies

(Family reconstitution studies of German villages for couples married before 1850)

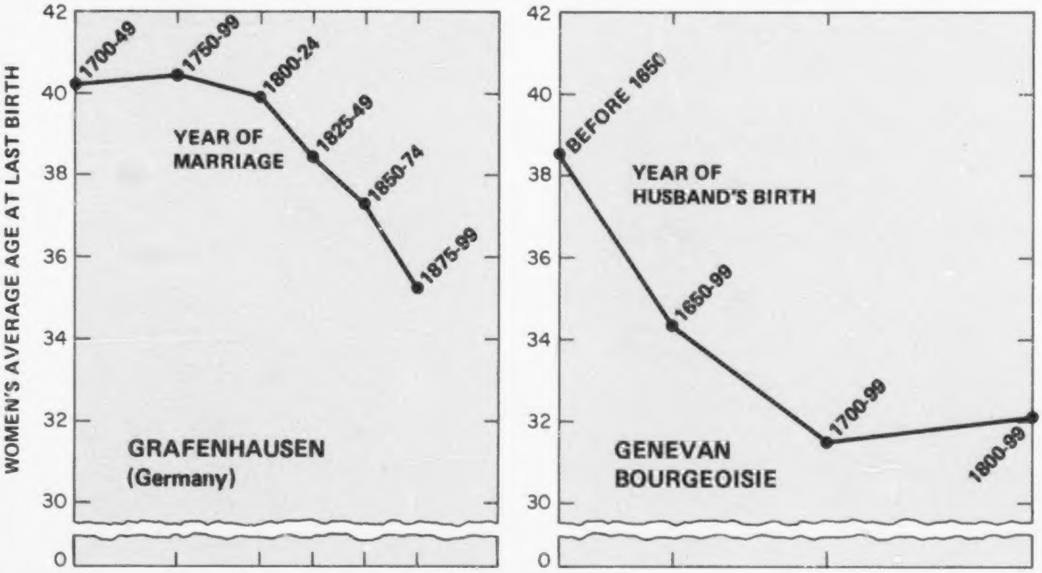
Location	Total Marital Fertility Rate[a]	Index of family limitation (m)[b]
3 villages, Bavaria	10.0	.03
4 villages, Waldeck (Hesse)	8.4	–.02
2 villages, East Friesland	7.6	.16

Sources: Knodel, 1978 (see Table 2), and previously unpublished results from research by Knodel.

[a] The Total Marital Fertility Rate equals the sum of the age-specific marital fertility rates for each five-year age group above age 20 multiplied by 5. It represents the number of births a woman would have who married at age 20 and remained married at least through age 49.

[b] For explanation, see text page 14.

Figure 4. Trends in Average Age of Women at Last Birth: Grafenhausen and Genevan Bourgeoisie, 17th-19th Centuries



Sources: Knodel, 1978 (see Table 2); and Louis Henry, *Anciennes familles genevoises*, Institut National d'Études Démographiques Cahier No. 26 (Paris: Presses Universitaires de France, 1956).

pregnancy. The effect can be to extend the average birth interval for as much as 12 to 18 extra months.[9]

From various sources, we know that breastfeeding was not customary in the 19th century and probably even earlier in the areas where the three Bavarian villages of Table 3 are located but was quite common and probably averaged close to a year after each birth in East Friesland. This probably explains much of the difference in predecline fertility levels between the two sets of villages.

Measuring family limitation

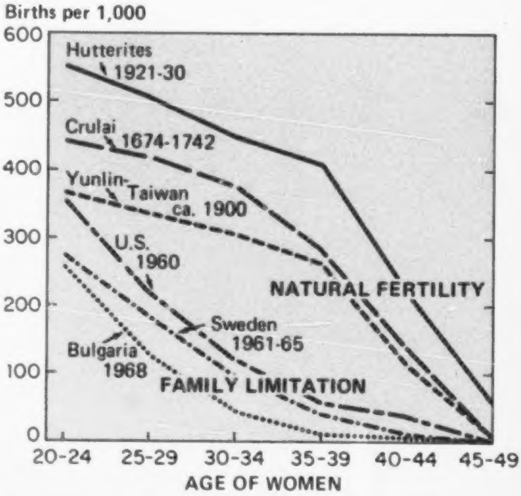
One of the important advances of modern historical demography has been the development of indirect techniques to determine whether married couples were practicing family limitation. These techniques are based on measures which can be derived from family reconstitution data and sometimes from official statistics, such as fertility rates of married women at different ages and the age of mothers at last birth. They are based on the observation that couples generally terminate childbearing earlier and marital fertility declines more rapidly with age where family size is deliberately limited than in natural fertility situations. The reason for this is that most married couples who wish to limit the children they have concentrate their childbearing in the earlier part of the wife's fertile period. Where family limitation is common and birth control widespread, women are considerably younger when they finish childbearing than they are in natural fertility populations. Women married in the 1950s in the U.S., for example, were on the average around 31 years of age at the birth of their last child,[10] compared to the average of about 40 noted in pre-fertility-decline French and German villages.

Figure 4 illustrates how this age at

last birth declined during the historical fall in fertility in two populations for which family reconstitution studies are available. Grafenhausen is a German village where the transition from natural fertility to family limitation began unusually early. As can be seen, the average age of mothers at their last birth declined steadily for couples married during the 19th century. The Genevan bourgeoisie represent a very different population. They were an elite group who began practicing family limitation early in the 17th century, far ahead of other European couples. They show the same drop in the age of mother at last birth although at an earlier time. Naturally, as long as couples have children at all, the mother's age at last birth cannot decline indefinitely and, as we see for the Genevan bourgeoisie, it eventually levels off.

Figure 5. Marital Fertility Age Patterns with Natural Fertility and Family Limitation

(Age-specific marital fertility rates, i.e. births per 1,000 women in different age groups)



Source: John Knodel, "Family Limitation and Fertility Transition: Evidence from the Age Patterns of Fertility in Europe and Asia," *Population Studies*, Vol. 31, No. 2 (July 1977) Figure 1, p. 222.

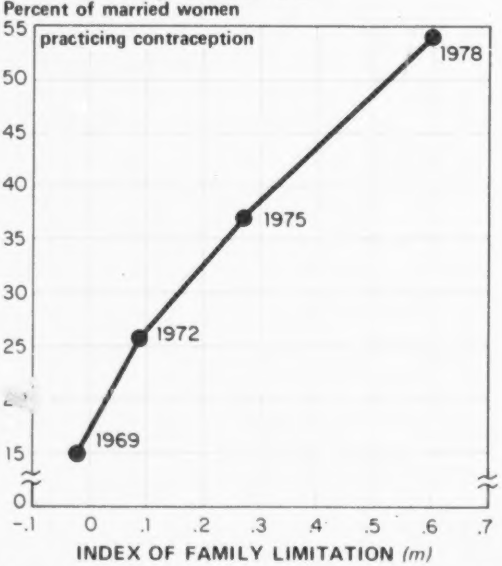
A more complicated but extremely valuable indicator of family limitation has recently been developed by Ansley Coale and James Trussell.[11] Their index of family limitation, called *m*, is based on the observation that the age pattern of marital fertility reflects the degree of family limitation practiced in a population. In natural fertility populations, the overall level of fertility may vary widely, as we have seen. However, the reasons for these differences generally have nothing to do with the number of children born and the main thing that affects the shape of the fertility curve—or pattern of age-specific marital fertility rates—over women's childbearing years is the decline in the physiological ability to bear children as they approach their forties. The three natural fertility populations shown in Figure 5 (the Hutterites of North Dakota in the 1920s, Crulai, a French village before 1750, and a Taiwanese village about 1900) actually had very different levels of overall marital fertility. However, in all three, marital fertility rates remained relatively high until age 35-39 before falling off. The other three populations in Figure 5 (the U.S., Sweden, and Bulgaria in the 1960s) display the very different pattern typical in populations where family limitation is common: marital age-specific fertility rates fall much sooner and faster as women move through their childbearing ages.

The Coale-Trussell index of family limitation is calculated by comparing the age pattern of marital fertility rates in a given population with a "standard" natural fertility pattern, based on a series of populations that are presumed to practice little or no birth control. The index *m* is constructed so that it will equal zero if the shape of the fertility schedule in question is identical to that of the standard natural fertility schedule. The faster marital fertility falls with age, the greater the amount of fertility control implied and the higher the value of *m*. Small differences in *m* values do not necessarily indicate meaningful differences in the extent of family limitation, nor do slight departures from zero necessarily indicate meaningful deviations from natural fertility. In the villages shown in Table 3 (page 12), for example, the value of *m* varied slightly but remained close enough to zero to suggest that family limitation was not practiced. On the other hand, modern populations in which contraception is widespread, like the three at the bottom of Figure 5, usually have *m* values well over 1. Thus, moderate or large differences in *m* between populations at one point in time or consistent trends over time in a series of *m* values can be interpreted with reasonable confidence as reflections of different degrees of fertility control.

In historical studies of fertility, of course, we have no direct information on birth control. For modern populations in both the West and the developing world, however, there are survey data on the extent to which couples practice birth control. Using such data for Thailand, Figure 6 shows how the increasing practice of birth control corresponds with a rise in the value of *m*. The results are similar for others of today's developing countries. This helps confirm the value of the *m* index as a proxy for direct information on family limitation.

The rise in *m* values as Europe's historical fertility transition progressed is illustrated in Figure 7 (next page), based on three family reconstitution studies which were chosen to represent diverse geographical, socioeconomic, and cultural settings. The village of Grafenhausen is located in southwest Germany and Meulan is a small town in France. In both these populations, as well as in the two Hungarian villages, *m* shows a steady increase once it moves much above zero, signaling the onset and spread of family limitation. It is interesting that in these three quite different settings the age pattern of fertility shifted in a similar manner.

Figure 6. Index of Family Limitation (m) and Percent of Married Women Practicing Contraception: Thailand, 1969-78

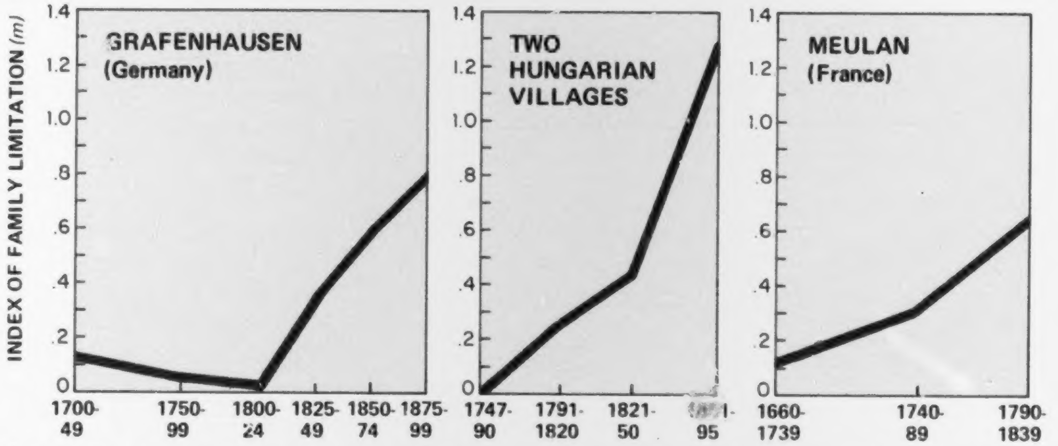


Sources: *National Longitudinal Study of Social, Economic and Demographic Change* conducted by the Institute of Population Studies, Chulalongkorn University, Bangkok; *Survey of Fertility in Thailand* conducted by the Institute of Population Studies, Chulalongkorn University, and the National Statistical Office of Thailand; and *Survey of Contraceptive Prevalence* conducted by the National Institute of Development Administration.

Macro-level fertility measures

The recent macro-level studies of Europe's historical fertility transition have also developed ingenious measures to follow the transition from the data available, this time for national or provincial populations. Formerly, most macro-level studies concentrated on trends in the crude birth rate—the number of births in a year per 1,000 of the total population in that year. This can be very misleading. For example, France and Ireland around 1900 had almost the same crude birth rate. This result was obtained in France by family limitation (within marriage) and in Ireland by high proportions of single persons in the reproduc-

Figure 7. Index of Family Limitation (m): Grafenhausen, Two Hungarian Villages, and Meulan, 17th-19th Centuries



Sources: Knodel, 1978 (see Table 2); Rudolf Andorka, *Determinants of Fertility in Advanced Societies* (New York: The Free Press, 1978); and Marcel Lachiver, *La population de Meulan du XVIIe au XIXe siecle* (Paris: SEVPEN, 1967).

tive ages. The more recent macro-level studies in historical demography have emphasized the importance of "decomposing" a country or province's overall fertility into the components that influence that level: the fertility of married couples, fertility outside marriage, and the proportion of the population that is married.

As part of Princeton University's European Fertility Project, Ansley Coale devised a set of indices which permit this kind of decomposition of overall fertility from the type of data available in published census and vital statistics reports.[12] The censuses which started in most Western countries toward the end of the 19th century commonly recorded the ages and marital status of the population while vital statistics reports provided time series of the number of births, classified as legitimate or illegitimate (but generally not classified by age of mothers). The Coale indices provide measures of overall fertility and also of its three components: marital fertility, non-marital fertility, and the proportions of married women at different ages.

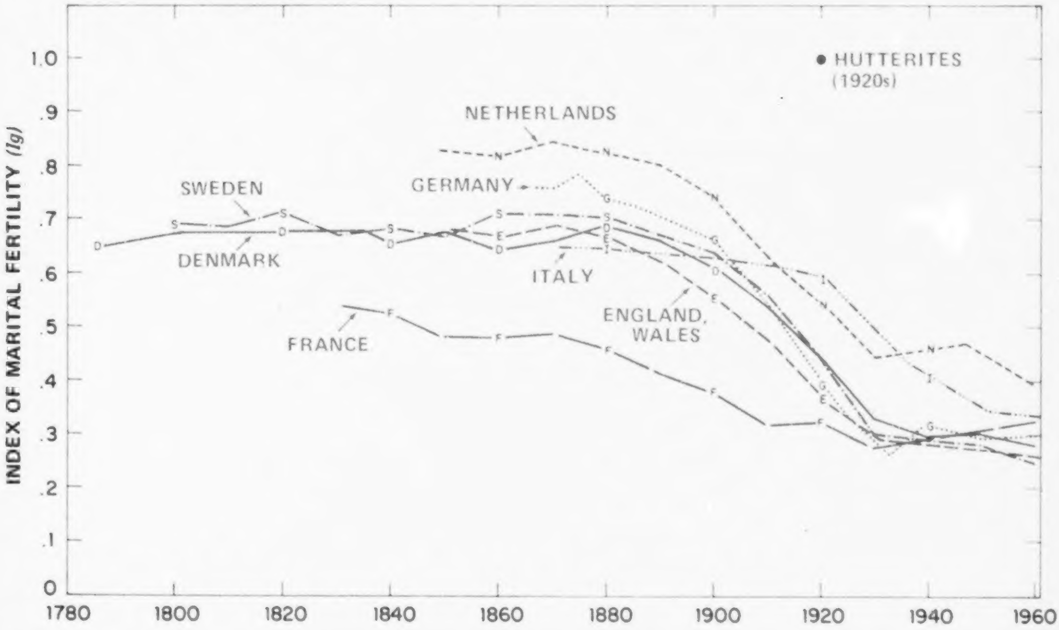
This is the logic behind the index of marital fertility, called I_g, the most useful for following 19th century trends in European fertility. We know from the vital statistics the number of legitimate births that married women in any given country or province have had in a particular period. We compare this number with the number of births we would expect them to have, knowing the number of married women in each age group from the census, if these women experienced the highest marital fertility ever reliably recorded for an entire population. The ratio of the actual to the expected number of births is the index of marital fertility. This index can be calculated for women at different times and places and compared either across populations or over time. The scale of comparison was chosen so that there would be a maximum value unlikely to be exceeded by European populations. As the standard, Coale selected the fertility of Hutterite women of North Dakota married in the 1920s. This is considered the record as human fertility goes. A small religious sect, the Hutterites are a prosperous rural population with a pattern of breastfeeding that keeps birth intervals short, and their creed forbids birth control of any kind. They are a well documented example of natural fertility in the 20th century. The average Hutterite woman of the 1920s, married at age 20, would have had 11 children.

For comparison purposes, the marital fertility index (I_g) of the Hutterites is given the value of 1. No national population of the 19th century reached that level, but certain provinces came close: Flanders, or Schwabia, about 1860, for example, had a marital fertility at 95 percent of the Hutterites. And some family reconstitution studies have revealed villages where I_g even exceeded 1 for certain periods, although rarely by more than a few percent.

Figure 8 traces the trend in the I_g index over time in seven European countries compared with that of the Hutterites in the 1920s. Two things should be noted. First, where the lines can be drawn back far enough, it is usual to find I_g on a high plateau, with only minor fluctuations, until a decisive and irrevocable plunge occurs. Second, this high predecline level varies from country to country, but is usually between 60 and 80 percent of the performance of the Hutterites. The trend for Denmark shown in Figure 8 emphasizes these two points. From the census of 1787 on to 1880, marital fertility hovers at about 65 percent of the Hutterites. While the reasons for the relatively low predecline level of fertility are uncertain, the quick drop in Denmark's marital fertility after 1890 clearly represents a break with the past.

Prior to the Princeton fertility project, which yielded these data, and the family reconstitution studies discussed in the

Figure 8. Index of Marital Fertility (I_g): Selected European Countries, 1787-1960



Sources:

England and Wales, France, Italy, Netherlands, Sweden: Princeton European Fertility Project.

Denmark: Etienne van de Walle, "Problèmes de l'étude du déclin de la fécondité européenne," *Recherches Economiques de Louvain*, No. 4, 1969.

Germany: John Knodel, *The Decline of Fertility in Germany, 1871-1939* (Princeton: Princeton University Press, 1974).

previous section, some demographers assumed that marital fertility in the past remained not only relatively constant, but also almost uniformly high from country to country. Before family limitation became common, they felt, reproduction within marriage must have been governed mainly by human physiology. According to this reasoning, we might expect that the Hutterite level would provide a reasonable upper limit, and deviations from this would indicate the use of contraception. We now know this not to be the case. Predecline levels of I_g or other measures of marital fertility tend to be relatively constant over time but vary greatly among countries, provinces, or villages. Moreover, urban marital fertility was usually below the level of rural areas. We know better today than to attribute fertility differentials in the past automatically to deliberate birth control. The factors which explain these variations are poorly understood. They may include some birth control. More probably, as already mentioned, they represent a mix of physiological factors, social customs, and health factors related to the environment or to hygiene. Differences in breastfeeding customs or in the frequency of sexual relations, nutritional deficiencies, or perhaps the prevalence of diseases such as tuberculosis or gonorrhea, about which little evidence has surfaced, are all potential culprits. For whatever reasons, however, it is clear that marital fertility was consistently high in some parts of preindustrial Europe and low in others.

Leaving aside the differences in the predecline level of marital fertility and concentrating on the trends, we see that there are no sustained, one-way trends, except in France (Figure 8), much before 1880. Table 4 shows index numbers of marital fertility to 1910 for selected countries, with the value of I_g for 1880 set at 100 for each. Values above 100 indicate that I_g was above the 1880 level and values below 100 indicate that I_g was below that level. Only in Belgium and Switzerland had the decline in fertility clearly started before 1880. Wherever the data go back far enough, we find a plateau of high marital fertility, terminated quite abruptly by a clear downfall.

If we had to rely solely on this more-or-less level plateau in the marital fertility index, it would be difficult to infer that family limitation was not practiced during the predecline period. However, we also have the findings from family

Table 4. Index Numbers of Marital Fertility: Selected European Countries, 1850-1910

(I_g in 1880 = 100)

	Date									
Country	1850		1860		1870		1880	1890	1900	1910
Belgium		109		109			100	89	71	59
Denmark	99		94		96		100	97	89	77
England-Wales	100		99		102		100	92	82	69
Germany					103		100	96	90	73
Ireland					99		100	101	100	101
Italy				105	100		100	99	98	95
Netherlands	100		98		102		100	97	90	78
Norway				93		100		98	93	90
Scotland			101		103		100	95	86	77
Sweden	96		101		101		100	96	91	80
Switzerland			107		102		100	96	91	76

reconstitution studies of many village populations in various countries, using the indirect techniques already discussed. They generally indicate an absence of family limitation in the 17th and 18th centuries, the period to which most refer. Where family limitation is evident, it usually emerges only after an earlier period of natural fertility. In addition to this evidence, data are available for a few countries on age-specific marital fertility which allow the computation of *m*, the index of family limitation, at the national or state level in the pre-fertility-decline period (see Table 5). All of these predecline *m's* are close to zero, meaning that the age distribution of fertility reveals little or no birth control within marriage. Moreover, in the one country where we can compute both I_g and *m* from 1800 on, Sweden, the beginning of the sustained decline in I_g coincides with a transformation in the age distribution of fertility as revealed by the start of a steady increase in *m*. (See Figure 9, page 27.) Definitions of *m* and I_g for quick reference are given in the box on the next page.

Marital fertility is the key variable in the fertility transition, but a word must be said about the other Coale indices. Another potent factor of variation in overall fertility has nothing to do with marital fertility. It is the proportions of women in the childbearing ages who are married. The effect of this is measured by the index I_m. If every woman in a population got married at 15 and remained married until 50, I_m would be equal to 1, and overall fertility (expressed by a third index, I_f) would be equal to marital fertility (or I_g). In fact, the effect of celibacy, late marriage, and marriage dissolution reduces I_f, the index of overall fertility, in all populations, but this varied a great deal among European countries. In 1900, for example, the proportion married, I_m, ranged from .325 in Ireland to .731 in Bulgaria. This means that in Ireland, where women married late if they married at all, 67.5 percent of potential fertility was "lost" because of the prevailing pattern of marriage. In Bulgaria, thanks to early and almost universal marriage, the loss of fertility was only 26.9 percent.

Table 5. Index of Family Limitation (m) Before Fertility Decline: Selected Western Populations

Country and date	Index of family limitation (*m*)
Denmark, 1860-69	.18
Finland, 1871-80	.08
New South Wales, Australia, 1871	.13
Norway, 1[illegible]4-76	−.13
Scotland, 1855	.21
Sweden, 1871-80	.80

Data computed from the following sources:

Denmark: Etienne van de Walle, "Problèmes de l'étude du déclin de la fécondité européenne," *Recherches Economiques de Louvain*, No. 4, 1969, p. 282.

Finland and Sweden: Jokinder Kumar, "A Comparison of Indian, Swedish, and Finnish Fertility," *Population Studies*, Vol. 25, No. 2 (July 1971) p. 271.

New South Wales and Scotland: C. J. Lewis and J. Norman Lewis, *Natality and Fecundity: A Contribution to National Demography* (New York: Arno, 1976 reprint of 1906 edition) p. 44.

Norway: Louis Henry, "Some Data on Natural Fertility," *Eugenics Quarterly*, Vol. 8 (March 1961) p. 84.

The combination of nuptiality patterns and fertility within marriage yield very different overall levels of fertility. In Eastern Europe, overall fertility tended to be higher than where the Western European pattern of marriage prevailed. In Russia, about 1900, I_f was .546. This means that overall fertility reached 54.6 percent of what it would have been if all Russian women, whatever their marital status, had reproduced as vigorously as the married Hutterites. At the same time, the reproductive strategies prevailing in France (high nuptiality and contraception within marriage) and in Ireland (late marriage and much celibacy combined with uncontrolled marital fertility) were producing much lower, but almost identical overall fertilities. The indices of this period for these three

Key Measures for Studying Historical Fertility Trends

m = Index of Family Limitation

Equals zero or close to zero in natural fertility populations. Rises in value as numbers of births to married women at older ages fall, indicating that couples are increasingly attempting to stop childbearing before women reach the physiological maximum age for childbearing (av. = about age 40). Usually calculated for small historical populations, based on data for individual families derived from church records of baptisms, marriages, and burials.

Example:

For Grafenhausen, a German village, m stood at .01 in 1800-24; .49 in 1825-49; and .79 in 1875-99.

I_g = Index of Marital Fertility

Differs in value from 1.0 as annual births to married women of different ages in a population fall short of the age-specific fertility recorded in the 1920s for married women of the Hutterites of North Dakota (av. completed family size = 11 children for women married at 20 and surviving with husbands to age 50). Usually calculated for populations at the national or provincial level, based on data from censuses and official birth records.

Example:

Denmark's I_g was .678 in 1801; .686 in 1880; .609 in 1901; .327 in 1930; and .283 in 1960 (i.e., 28.3 percent of the childbearing performance of the average Hutterite married woman in the 1920s).

countries were as follows:

	Marital fertility I_g	Proportion married I_m	Overall fertility I_f
Russia, 1897	.773	.687	.546
France, 1901	.383	.543	.238
Ireland, 1901	.706	.325	.235

Note that the effects of I_g (marital fertility) and I_m (proportion married) multiply to give I_f (overall fertility). Thus, for Ireland, the value of I_f, .235, is close to the product of I_g and I_m (.706 × .325 = .229). The difference is accounted for by illegitimate fertility which in general was relatively low in these historical societies. These indices provide convenient instruments to distinguish the effects of nuptiality and marital fertility which would be confused in the usual measurements such as the birth rate. This can be done in most of the administrative units of Europe, and provides a unique, if still rough, image of its fertility history.

Interpreting the New Findings

The overall picture that emerges from the micro-level studies based on family reconstitutions, the macro-level studies based on conventional demographic sources, and the gaps filled with the help of suggestions from social history and contemporary observers leads us to four main conclusions which have important bearing on our understanding of the process of fertility decline. They can be summarized as follows:

1. The past was largely characterized by natural fertility, that is, the deliberate practice of family limitation was mostly absent (and probably unknown) among most of the population prior to a fairly recent time. This was true, even though a substantial proportion of births may have been unwanted. High infant and child mortality may have reflected unconscious efforts to eliminate unwelcome children.

2. The transition from high to low fertility represented a shift from natural fertility to family limitation, occurred rapidly, and was an irreversible process once under way.

3. The onset of long-term fertility decline was remarkably concentrated in time and took place under a wide variety of socioeconomic and demographic conditions.

4. Differences in the start and in the speed of the fertility decline seem to have been determined more by the cultural setting than by socioeconomic conditions.

These observations are elaborated in the next sections of the *Bulletin* before we turn to the lessons that the findings suggest for the prospects of fertility decline in today's developing countries.

Pretransition Fertility Behavior

From the new historical evidence it seems clear that, prior to the onset of the fertility decline in Western Europe, the practice of family limitation was largely absent; the available means of birth control were ineffective, unknown, or unthinkable for married couples; but substantial portions of the population may have harbored latent motivations for reduced fertility.

Absence of family limitation

As we have seen, recent research suggests that if the data were available it would be possible to go back to a time in every population when fertility was natural and family limitation unpracticed. From selected micro-level studies, we see that prior to the long-term decline in fertility in Western Europe the index of family limitation, m, was close to zero and unchanging and the age of mothers generally around 40 at the time of their last births. At the same time, long plateaus of high fertility at the overall level of provinces and countries, as measured by the I_g index, suggest that there was no systematic attempt by significant proportions of married couples to control their fertility during this period.

We believe that family limitation was not practiced to any great extent at this time because birth control was not known or acceptable to a majority of people and thus did not constitute a real option for married couples. Indeed, the very idea that married couples could plan their family sizes was probably foreign to most people's mentalities. Our arguments are derived from indirect evidence, the only type available for the past. But they are largely confirmed by literary and cultural material.

Two arguments have been used to demonstrate that methods of birth control are always available in traditional societies and could have been used by married couples in pretransition Europe to curtail childbearing if they so desired. First, references to methods of contraception and abortion appear in many different cultural contexts. And second, at least one technique, withdrawal, seems to require no special knowledge or implements and presumably can be reinvented by every couple having some understanding of the mechanism of reproduction. But these arguments are deceptive.

It is true that birth control is discussed in almost all human cultures, and the preindustrial past of Western populations is no exception.[13] The medical literature inherited from the Greeks, the Romans, and the Arabs is quite explicit about various means of avoiding pregnancies. Unfortunately, however, the recommended methods were mostly ineffective. "Potions of sterility," which were vigorously condemned by theologians and moralists, either never existed, or derived their supposed power from magic or "placebo" effects.[14] If any oral contraceptive existed before the invention of the pill about 1955, the recipe has been lost. The potions of sterility may have been abortifacients. However, informed medical opinion today contends that no effective substance has come down from the past that can reliably procure the interruption of a pregnancy. Desperately trying to abort their pregnancies, large numbers of women in the late 19th and early 20th centuries were ingesting a surprising variety of chemical or vegetable drugs, quinine, phosphorous, and various infusions of herbs. Often dangerous to the mother, these substances sometimes produced the desired effect. But it is pointed out that, "Since at least ten percent of all conceptions end in spontaneous abortion, it follows that if ten women take sugar lumps as abortifacients one will 'successfully' abort."[15]

Effective methods of abortion and contraception *did* exist. Sharp instruments were used to kill the fetus. However, this was extremely dangerous for the mother and probably reserved for pregnancies where the shame of birth would have been worse than death, that is, outside of marriage. Condoms appeared early on the scene but were used mostly with prostitutes as protection from syphilis, and Condorcet at the end of the 18th century believed that as a contraceptive "this means has been up to now absolutely useless for the human species because it remains little known"[16] Some English propagandists of the early 19th century favored the sponge because it was a female contraceptive and they thought men could not be trusted with the most universally accessible birth control technique, withdrawal or coitus interruptus.

Condemnation of the "sin of Onan" goes back to the Bible but, strangely, withdrawal occupies little place in the voluminous theological discussion of contraception.[17] Islamic literature has long discussed and generally approved of withdrawal for contraception, but mostly in extramarital contexts. In the West, coitus interruptus is rarely cited before the 18th century, although it was well established in France by 1800 and there is little doubt that this is the method that was initially most responsible for successful family limitation when Europe's fertility transition eventually began. English social reformers, seeking ways to reduce the large burden of children on the working classes, noted its widespread use in France in the early 19th century and church archives from the time reflect the growing problem of "conjugal onanism." But this simplest method, which appears accessible to every couple, may have been unknown, unacceptable, or for practical purposes unavailable to most motivated couples before a fairly recent date.

Could it be that withdrawal is less obvious than it seems as a way to avoid conception and has to be learned from the outside? Or does the key to its late adoption lie in the fact that coitus interruptus is a male method and threatened what was seen as the male prerogative of sexual pleasure? Possibly women were able to impose its practice only when they had achieved equality within marriage. Margaret Sanger hints of this in her description of working class families in New York at the beginning of this century:

> "The menace of another pregnancy hung like a sword over the head of every poor women I came in contact with that year. The question which met me was always the same: What can I do to keep from it? or what can I do to get out of this? Sometimes they talked among themselves bitterly. 'It's the rich that know the tricks,' they'd say, 'while we have all the kids.' Then, if the women were Roman Catholics, they talked about 'Yankee tricks,' and asked me if I knew what the Protestants did to keep their families down. When I said that I didn't believe that the rich knew much more than they did I was laughed at and suspected of holding back information for money. . . . The few simple means of limiting the family like coitus interruptus or the condom were laughed at by the neighboring women when told these were the means used by men in the well-to-do families. That was not believed, and I knew such an answer would be swept aside as useless. . . ."[18]

Useless, because women did not believe they could convince their men. We suspect that similar attitudes have kept married couples from limiting their families even after practical methods were within reach of individuals.

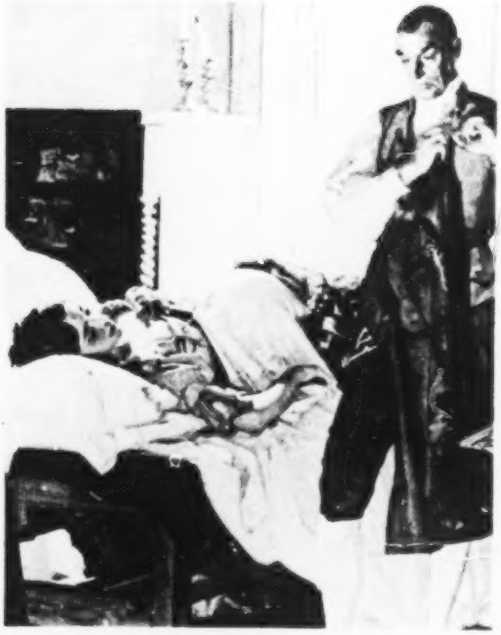
The same was probably true of abstinence. It is likely that abstinence was generally recognized as a means of avoiding pregnancy, but this too requires male cooperation and means repeated denial of immediate pleasure for the much more distant benefits that may be perceived in connection with avoiding childbirth. And men did not have the same stakes as women in avoiding the dangers of childbearing and debilitating effects of closely spaced pregnancies. One of the few actions women themselves could take to reduce their fertility was to deliberately prolong breastfeeding. Contemporary observers mention that some women did indeed do so, however ineffective and inconvenient that might be.[19]

Literary references abound to suggest that family limitation was generally deemed impractical or scandalous behavior. Churches opposed it on moral grounds. And even when they were not invoking a moral argument, most philosophers thought, as did Diderot, that "in spite of all the contrary resolutions and systems, it is impossible for men to cheat the wish of Nature in such a way as to influence population ever so little."[20] Writing in his First Essay of 1798, Malthus also declared that "towards the extinction of the passion between the sexes, no progress whatever has hitherto been made."[21] In other words, couples would inevitably bear children once married. Under the pen of Malthus and many of his predecessors and contemporaries, celibacy and late marriage rather than family limitation appeared as the normal means to avoiding the burdens of a large family. In this, they were substantially describing the situation of their time where family size was primarily determined by the wife's age at marriage and the time lived in wedlock before death parted the spouses. In French and German villages of the 18th century, two to three years of marriage produced one additional child on the average. Getting married depended on material assets such as a piece of land or a trade; thus it appears that societal mechanisms rather than individual foresight served to adjust the size of the population roughly to the available resources. In frontier situations as in America or on the agricultural plains of Eastern Europe, marriage was earlier and more universal than in the old countries of Western Europe and population growth was higher.

Unwanted births

It has been argued that natural fertility in the past can be explained in another way than by the non-availability of birth control: couples had little motivation to limit childbearing because they wanted many children—more than the number likely to survive under conditions of high mortality. Indeed, this is often given as the reason why fertility remained high for as long as it did. But is it true that "the age-old attitude toward high fertility was always similar to the attitude toward longer life: high fertility was considered a blessing"?[22] We believe the answer is no and that in many areas of Europe during the 18th and 19th centuries significant numbers of births were unwanted, especially by their mothers, but that this did not result in use of such birth control methods as were available.

There are obvious instances where the motivation to avoid childbearing existed. Fertility outside of wedlock must always have been one of them. We now know that illegitimate fertility began to decline about the same time as marital fertility.[23] This can hardly have been a coincidence. Rather it suggests that birth control was not widely used before the parallel declines in legitimate and illegitimate fertility and that the spread of practical knowledge and skills to



For married women in the pretransition era, there was no escaping the dangers and pain of incessant childbearing.

avoid unwanted births enabled both unmarried and married couples to reduce their fertility simultaneously.

From literary and legal sources, there is much evidence that even the upper classes often did not want large families because of their cost. Writing of the English peerage, historian Lawrence Stone notes:

> "Despite the need to secure the succession, an overfull quiver was by no means a cause of unmixed satisfaction. . . . In 1536 the Earl of Wilshire complained of poverty partly because his wife 'brought me forth every year a child' and both Lord North and the Earl of Northumberland advised against 'a multitude of unprofitable children.' The rise in the size of portions made girls peculiarly expensive and unwanted, though boys were still welcome so as to protect the direct male succession against the ravages of accident and disease. After three boys had been born, which was a situation which developed in at least one family in every five, there was a strong incentive to call a halt. It is therefore curious that there are few signs at this period of any practical steps being taken to prevent conception."[24]

The health of women of the aristocracy who were not breastfeeding and were therefore exposed to yearly pregnancies could be severely threatened in the era before contraception. Mme. de Sévigné's eloquent letters testify to this.[25] At 22, her daughter had married the 40-year-old Governor of Provence and had six deliveries in seven years. After a male heir was born in November 1671 (the third delivery), the grandmother wrote repeatedly to enjoin abstinence. In December 1671: "I beg you my love, do not trust the two beds: it is a subject of temptation. Have someone sleep in your room." In January 1672: "If Mr. de Grignan falls into temptation, don't believe he loves you!" In March: "Continue this nice custom of sleeping separately, and restore yourself. . . . I kiss your husband. I like him even better in his apartment than in yours." To her son-in law: "I warn you, if you don't give some rest to that pretty machine, out of affection and out of pity, you will destroy her without fail, and it will be a shame." Noting that he had "already killed two wives under him," she deplored his inattention to his wife's failing health. Abstinence was the only method Mme. de Sévigné recommended, however, and she made no reference to any other ways to avoid pregnancy.

The arguments against large families also struck a responsive chord in a large public beyond the upper classes. This comes through in French writings since medieval times, and can be confirmed from sources in other languages.[26] Because avoiding children within marriage was not an available option, much of the literature discusses the disadvantages of marriage, often taking a cynical and misogynist view, as in this verse recited for the groom at bourgeois weddings in France around 1530:

"He will have to feed children
Until they are of age
His daughters he has to marry
And give a huge sum to dowry

> And the boys he has to provide
> With an education or a trade
> The children need so many things
> As soon as they are born
> That the poor man goes naked
> And lives in great pain. . . .
> These are the goods that a wife brings with her."[27]

Thus, approximately the same arguments that contemporary parents use to justify family limitation were invoked by men against marriage. Defenders of the woman stressed that she got the worst of the bargain because she had to endure the dangers and pain of childbearing. Parallel to the economic and masculine argument against marriage, then, there developed a medical and feminine argument against excessive childbearing within marriage.

Infant mortality

High fertility in the past—and in developing countries today—is often viewed as an adaptation to high infant and child mortality. If this were true, we would expect that couples whose children all survived would adjust their reproductive behavior once reaching a desired number of children. But the evidence from village studies suggests that couples whose children all survived continued childbearing just as long as those who had lost some offspring; people's own experience with mortality hardly seemed to matter in determining future conceptions (see Table 6).

On the contrary, contemporary observers note that deaths of children were often welcomed as relief from the onus of parenthood. At the least, mothers and fathers were frequently indifferent to the loss of a child. Rudolf Braun describes attitudes among landless cottage workers in Zurich, Switzerland, at the end of the 18th century:

> "When Uli Bragger was cured of a dangerous illness, his father said to him: 'God has heard your entreaties. . . . I, however, I'm willing to admit, did not think as you did, Uli, and would have considered myself and you fortunate if you had passed away'. . . . Johan Schulthess wrote: 'Hence so many parents not only think about it, but wish loudly and openly for the death of their children. You can hear—I'm speaking now as a witness—a needy woman murmur against heaven because a child of a well-to-do neighbor has died: 'I am not so lucky,' she says. 'If one of my children fell off the bench, instead of his breaking his neck, two of them would spring up in his place.' And another woman, a gleaner, walking next to her pastor in the street and holding the hand of a lively child hardly recovered from the smallpox, says without shame in front of both of them: 'Oh, if it had only died of the smallpox.'"[28]

Table 6. Impact of Child Mortality on Pretransition Marital Fertility

(Age of mother at last birth by number of children dead before reaching age 10: German villages, marriages prior to 1850)

Number of deaths among first three confinements	Mother's age at last birth
0	40.4
1	40.9
2 or 3	40.7

Source: John Knodel, "Natural Fertility in Pre-industrial Germany," *Population Studies*, Vol. 31, No. 3 (November 1978) p. 505, where more detailed data are given on individual villages. Results refer to all ages at marriage for unions lasting until the end of the wife's childbearing years.

In England, smallpox was commonly called "the poor man's friend."

Such evidence hardly tallies with the contention that couples refused to use birth control because they wanted many children. Rather, it suggests that many women continued having children because there was little option to do otherwise.

Abusive child care practices and general neglect appear to have been common in much of Europe. Outright infanticide was not unknown, particularly among unwed mothers, but far more common were traditional practices that led to what social historians now call "unconscious infanticide" or "infanticide by neglect." Such practices included sending the new born baby out to a wet nurse; dosing the infant with gin or opiates to keep it quiet; rocking the infant violently in its cradle until it was knocked into insensibility; leaving the child swaddled and unattended in its own filth for hours on end; and having the baby sleep in the same bed with the parents, thus risking "overlaying" and suffocation.[29] The custom of hand-feeding rather than breastfeeding young infants, which was widespread in parts of Europe, had a particularly devastating effect, given the deficient nutritional content of the alternative foods fed to infants and the appalling hygiene of the day.

Many of these customs seem to have been aimed at relieving the mother from the drudgery of child care in a situation where women were expected to labor all day alongside their husbands and to assume all the house work. Although not found everywhere, collectively these practices surely contributed to the high infant and child mortality that characterized much of Europe in the 18th and 19th centuries.

One nearly universal practice that undoubtedly contributed directly to those statistics was abandonment or "exposure" of children.[30] Large numbers of children were involved. There were, for example, more than 7,000 foundings every year in Paris alone in the years before the French Revolution and their risks of dying in the "welfare" system were high. Data for the end of the 18th century suggest that a third of the abandoned children were legitimate, and many came from bourgeois, master craftsman, and merchant families. An edict of 1779 declared:

> "His Majesty has observed with sadness that the number of exposed children increases from day to day, and that most today originate in legitimate bonds, so that the asylums originally instituted to prevent those crimes to which shame might induce a misguided mother have progressively become deposits favoring the criminal indifference of parents."[31]

Carlo Corsini has unearthed remarkable data from the Hospital of the Innocents (or foundlings) of Florence in Italy.[32] Because the hospital kept records on the parental origin and fate of each baby, Corsini was able to link the children with their mothers in the nearby villages of Fiesole and South Godenzo. A large majority of the foundlings were legitimate children and, for the period 1775-94, they represented 4.2 percent of legitimate births in the two villages. (The percentages had been increasing throughout the 18th century, partly because of the hospital's growing liberality in reaction to deteriorating economic conditions.) Most interesting is the fact that abandonments were clearly related to the number of children in the family, as shown in Table 7. Apparently, Tuscan peasants of the 18th century were resorting to child abandonment as a means of family limitation. The situation cannot be held as typical since the institutions in Florence were making the procedure uncommonly convenient for overburdened parents. But this suggests that, given a chance, many parents would have attempted to limit their families. Corsini comments that abandonment of infants declines and

Table 7. Child Abandonment: Tuscany, Italy, 18th Century

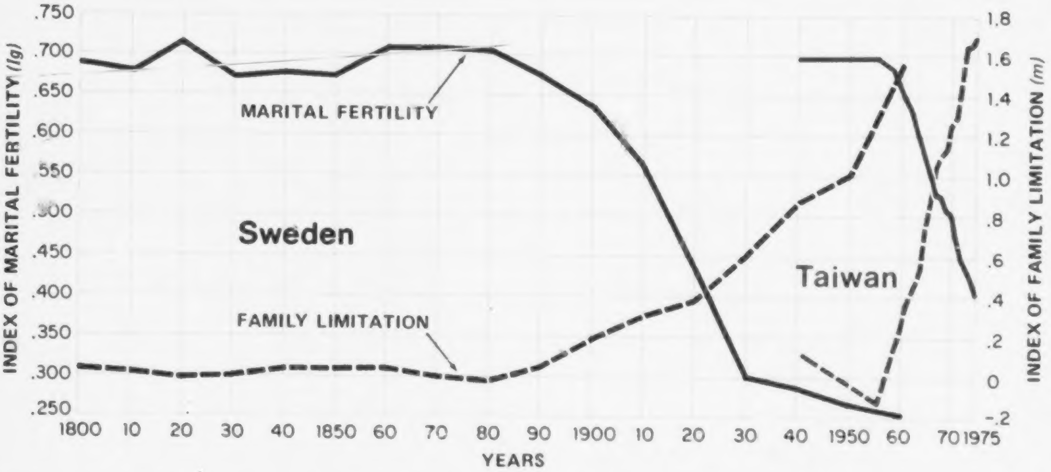
(Legitimate children abandoned at the Foundling Hospital of Florence by number of children in the family: two nearby villages, 1775-94)

Number of children in family	Percent of children abandoned
1-3	24.8
4-5	37.1
6 plus	50.6

Source: Carlo A. Corsini, "Self-Regulating Mechanisms of Traditional Populations Before the Demographic Revolution: European Civilizations," in International Union for the Scientific Study of Population (IUSSP), *International Population Conference: Mexico 1977*, Vol. 3 (Liège, Belgium: IUSSP, 1977), adaptation from Table 3, p. 12, and personal communication with the author.

Note: Refers to 170 children from 133 families who abandoned at least one child and for whom there are complete records

Figure 9. Index of Marital Fertility (I_g) and Index of Family Limitation (m): Sweden, 1800-1960, and Taiwan, 1940-75



Source: John Knodel and Etienne van de Walle, "Lessons from the Past: Policy Implications of Historical Fertility Studies," *Population and Development Review*, Vol. 5, No. 2 (June 1979), adapted from Figure 1, p. 223, with permission.

disappears after the middle of the 19th century: "this is concomitant with the diffusion of voluntary means of limiting conception."

It seems plausible that deliberate abandonment and negligent childrearing practices and the resulting infant and child deaths served as a way to limit family size in the absence of birth control, particularly in view of the apparent unwillingness of parents to change their ways despite the frequent decrying of these practices by authorities. From this perspective, the high infant and child mortality rates found in much of Europe prior to the fertility decline can be considered as much of an accommodation to high fertility as the opposite. In other words, the conventional argument that couples maintained high fertility in part to counteract high infant and child mortality may have the causal ordering reversed, a conclusion which recent research in Latin America suggests may also be true of developing countries today.[33] Such an interpretation helps explain why marital fertility began to decline in some areas of Europe while infant mortality was still very high.

In sum, the literary evidence and commentaries of contemporary observers are consistent with the idea that family limitation was not practiced in pretransition Europe because birth control was largely inaccessible, unknown, or unthinkable for married couples. However, the motivation to avoid excessive childbearing existed and was met, at least partly and largely unconsciously, by such palliatives as late marriage, child neglect and abandonment, or even infanticide.

Irreversibility of Family Limitation and Fertility Decline

The shift from natural fertility to family limitation and the resulting decline in marital fertility reflected a radical change in the reproductive behavior of couples and societies. It was sudden and proceeded irreversibly until much lower levels of fertility were reached.

The time series shown in Figure 9 for the index of family limitation, *m*, and the index of marital fertility, I_g, for Sweden, which began its fertility transition in the late 19th century, and for Taiwan, where fertility began to fall only two decades ago, are remarkably similar. In both countries, once the *m* index starts to rise above a minimal level and once the I_g index starts to fall below the predecline level, the trends continue uninterruptedly until radically different levels are reached. Only the pace differs: very fast in Taiwan and slow in Sweden.

This association of rising *m* values with the decline in marital fertility helps confirm that the fertility transition resulted from a new form of reproductive behavior rather than from an extension of previous patterns. Recall that the *m* index measures the age pattern of marital fertility, independently of the overall fertility level. The rising *m* values mean that the fertility transition was set off by a marked decline in women's fertility at older ages, or stopping behavior. Before the transition, any differences there were in fertility levels were due to differences in spacing between births, whether or not deliberate, and not to the age at which women bore their last child, which, as we have seen, averaged around 40 in all populations for which we have data. Thus it was stopping behavior—or what we call family limitation—rather than birth spacing that was responsible for touching off the descent of fertility toward modern levels. Average birth intervals remained fairly constant as fertility started to drop. It was only at a later stage of the transition that a lengthening of birth intervals contributed to reduced fertility levels.

From recent research we know that the patterns for Sweden shown in Figure 9 were typical of Europe's historical record. Once family limitation rose above a minimal level, it continued to increase steadily until much higher levels of control prevailed. Marital fertility began falling about the same time and similarly continued falling until it reached a level at least 50 percent below what it had been in the predecline era. This irreversibility of the trends once started can be seen in national, provincial, and village populations and even in social elites and other groups where the transition began unusually early. To judge from the data on Taiwan and indeed from other developing countries (most of which are at an earlier stage of their fertility decline), this experience is being repeated in many of today's developing countries, although at a greatly accelerated pace. Increases in family limitation and declines in marital fertility seem to be one-way processes that generate their own momentum.

As already noted (Figure 6, page 15), the rise in the *m* index of family limitation in Thailand corresponds with survey data on increasing percentages of married women who practice contraception and this relationship has also been found in Taiwan. Although similar data are unavailable for Sweden and other Western countries at the start of their fertility transition, it is likely that deliberate birth control was also responsible for the shift there. The methods were different, of course. With reliance being placed mainly on withdrawal and possibly abortion, family limitation gained ground much more slowly in Sweden than in Taiwan where efficient modern contraceptives are now readily available. But it is striking that the trend toward terminating childbearing at increasingly earlier ages was nonetheless similar in the two countries.

The family limitation which ushered in the fertility transition represented a radical change in attitudes toward childbearing. Under the natural fertility regime, people did not recognize that fertility could be manipulated. With family size dictated by marriage and physiology, couples accepted, however reluctantly, as many children "as God sends." The transformation that occurred when the fertility decline began was a recognition that couples could aim for specific family sizes and had the capability to act according to these preferences. With the advent of efficient contraception, the rules of the game changed: most women now spend much of their reproductive life trying to avoid excess births. Fertility still varies in the post-transition era but this is usually because some groups are better able to control their fertility than others (the better off frequently practice more effective contraception than the poor, for example) or have different family-size targets (until recently, Catholics in the U.S. desired more children than Protestants).

The innovation of controlling the number of children born rather than leaving it to fate had a wide appeal when it appeared in the Western world. Once some couples in a community had adopted the new pattern of behavior, it became increasingly easy for other couples to follow suit. The cost of going against religious teachings and social standards that had served as barriers to the use of family limitation decreased rapidly as couples became aware that others were violating the old norms. Desired family size itself evolved downward as the advantages of control were increasingly perceived and as methods were developed by which smaller and smaller family sizes could be attained. Once started, the transition could not easily be stopped or reversed; it was a one-way street.

Although levels of marital fertility have fluctuated in Western countries in the post-transition era, these fluctuations have been relatively minor compared to the once-for-all decline. Completed family size dropped from about 7 to 3 children during the fertility transition. The post-World War II American baby boom, on the other hand, represented a movement only from about 3 to 4 children and was by no means a return to less controlled fertility. Parents did not relinquish their capacity to make conscious fertility decisions. Rather, the baby boom was largely the result of a shift upward in desired family size and this was obtained while the average age of mothers at the birth of their last child was still coming down.

Time Concentration and Socioeconomic Context of the Decline

The start of the West's fertility transition was remarkably concentrated in time and occurred under remarkably diverse socioeconomic and demographic conditions.

Contraception in the Roman Empire and in Islamic countries has left literary references but no statistical evidence and it was probably never widespread among married couples. As far as we can tell from recent historical demographic research, systematic contraception to limit family size originated with the French-speaking upper classes. The high nobility of France, the socalled Dukes and Peers of the Realm, are the first social group that can be reliably identified as practicing family limitation. By the end of the 17th century, the average age of women at the birth of their last child was down to the low thirties in this group.[34] At about the same time, the upper bourgeoisie of French-speaking Geneva also appears to have become a highly contraceptive group.[35] Their index of family limitation evolved as follows:

Date of husband's birth	Index of family limitation (*m*)
1550-99	.07
1600-49	.24
1650-99	1.15

By the 18th century, the Italian nobility had followed suit. The English nobility, however, were still untouched at mid-19th century.

Family limitation was widespread in

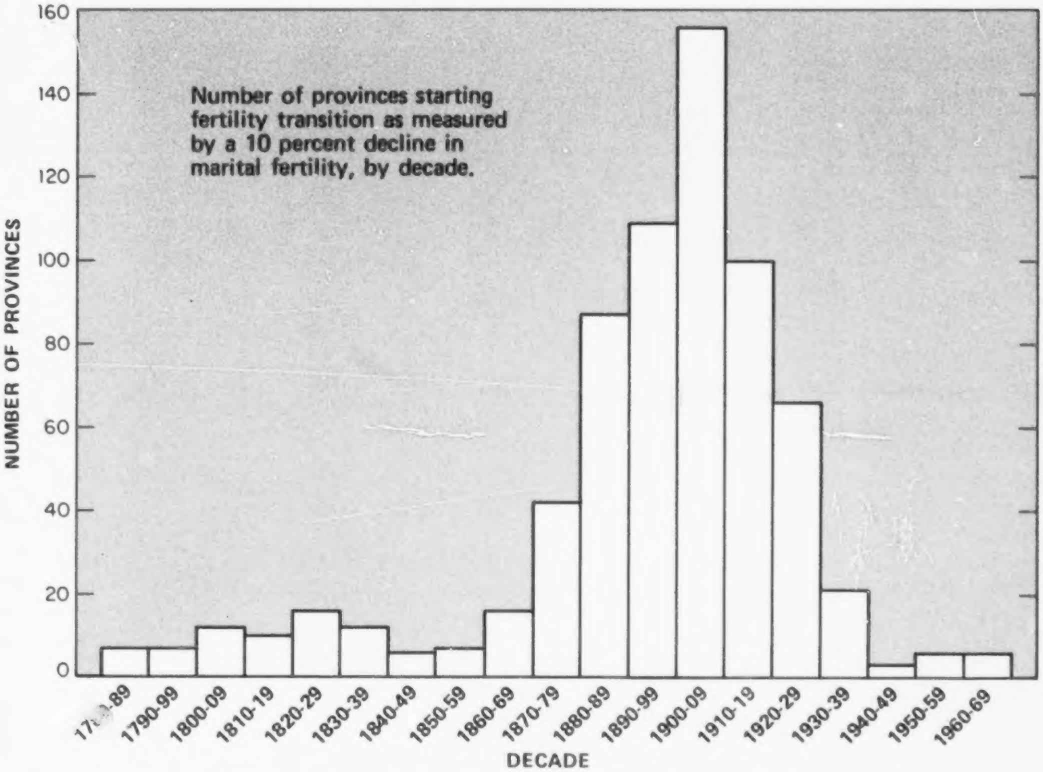
most of rural France by the last quarter of the 18th century, even before the French Revolution. On this, the recent studies confirm the opinion of the French demographer Moheau, writing in 1776, "They cheat nature even in the villages!" In the early 19th century, there were rural spots of family limitation in Germany, Hungary, and perhaps in Sweden and New England. These isolated examples, however, were too unrepresentative to cause clear trends in fertility indices computed from official statistics for entire provinces or countries. Also, there is some evidence that women's physiological ability to bear children was improving during the late 18th and 19th centuries. This tended to mask the impact of the early increase in family limitation on the level of marital fertility.[36] Among countries, only France and the U.S. showed visible signs in the early 19th century of a sustained decline in marital fertility. And it was only beginning about 1870 that the diffusion grew into a pandemic and progressively affected most European countries.

The results of the Princeton European Fertility Project yield estimates of the starting date of the fertility decline for countries and provinces. These are computed from standardized time series of the marital fertility index, I_g, similar to those illustrated in Table 4 (page 18). There were fluctuations during the predecline period of high fertility, but past a certain "point of no return" the fall of marital fertility had clearly begun. The starting date of the decline is put at the year the I_g index had fallen 10 percent below its peak recorded level, never to return again. For example, Denmark's I_g reached 90 percent of its peak level in 1900, just before the 1901 census from which we computed the I_g for around that time. When the 90 percent point was reached between censuses, the estimates were made by interpolation. Thus, for each country, a date was produced which we can presume to be the date when family limitation was established in a substantial proportion of the married population and the effect of the innovation had become cumulative and irreversible. These dates are given in Table 8 (page 32) for 17 European countries where the records extend back far enough and with enough regularity to cover the story from its beginning and also for four developing countries where marital fertility has begun to decline only recently.

Figure 10 shows the distribution of the equivalent dates for the some 700 province-size administrative units of Europe. This clearly demonstrates that the onset of the decline was extraordinarily concentrated in time. The long tail on the left of the graph is accounted for by the long-drawn-out history of marital fertility decline in France. France is characterized not only by its crucial role as the place where family limitation first found a foothold, but also by a wide spread in dates of decline; at the beginning of the 20th century, the *m* index of family limitation was still under .3 in some French departments (provinces). In England, by contrast, the starting date of the decline lay between 1890 and 1900 for almost all the 40 counties and for London as well. The progress of the fertility decline from its early French onset can be likened to a slow-burning fuse that eventually leads to an explosion: more than half of Europe's provinces initiated their fertility decline in the 30 years between 1880 and 1910.

The similarities in starting dates are not limited to contiguous countries in Western Europe. Countries overseas which received very large numbers of migrants at the time of the European transition were infected almost instantly. Demographers John Caldwell and Lado Ruzicka have noted the "extraordinary similarity between the course of birth rates in Australia and the United States, and the similarity between the fertility of these two societies over time and those of Britain, New Zealand, and English-speaking Canada."[37]

Figure 10. Starting Dates of Fertility Transition in 700 European Provinces, 1780-1969



Source: Ansley J. Coale and Roy C. Treadway, "A Summary of Changing Fertility in the Provinces of Europe," paper prepared for the Summary Conference on European Fertility," Princeton, N.J., July 23-27, 1979, Figure 7.

Socioeconomic context of the decline

Table 8 also shows various indicators of socioeconomic development in these 17 European countries at the time their fertility started downward. The most striking finding to emerge from these data is that Europe's fertility decline began under remarkably diverse socioeconomic and demographic conditions. In some countries, family limitation appeared only after considerable industrialization and urbanization had taken place. This was true in England where the rural proportion of the population was down to 28 percent and only 15 percent of employed men were working in agriculture at the time fertility started falling. But fertility began to decline at about the same time in Hungary which was then an overwhelmingly agrarian economy as was France when its transition began about 1800 and Bulgaria at the onset of its decline over a century later. Literacy was also at very different levels when fertility began to fall—low in France, Hungary, and Bulgaria, for example, and high in England and Wales.

There is no evidence that other indicators of socioeconomic development,

Table 8. Starting Date of Fertility Transition and Indicators of Concurrent Demographic and Socioeconomic Conditions: Selected European and Developing Countries

	Date of decline in marital fertility by 10 Percent	Marital fertility before decline (I_g)	Proportion of women married (I_m)	Overall fertility (I_f)	Infant deaths per 1,000 live births
European countries					
France	ca. 1800	.70	.51[a]	.30[a]	185[c]
Belgium	1882	.82	.44	.35	161
Switzerland	1885	.72	.44	.29	165
Germany	1890	.76	.50	.39	221
Hungary	ca. 1890	.63	.70	.45	250
England and Wales	1892	.68	.48	.31	149
Sweden	1892	.71	.42	.31	102
Scotland	1894	.75	.42	.31	124
Netherlands	1897	.85	.45	.35	153[c]
Denmark	1900	.68	.47	.32	131
Norway	1904	.75	.42	.30	76
Austria	1908	.68	.51	.36	205
Finland	1910	.70	.46	.31	114
Italy	1911	.68	.54	.36	146
Bulgaria	1912	ca. .70	ca. .74	ca. .45	159
Spain	1918	.64	.51	.30	158
Ireland	1929	.71	.35	.23	69
Developing countries					
Costa Rica	1962	.89[b]	.50[b]	.57	74
Taiwan	1963	.70	.70	.42	49
Chile	1964	.65[b]	.50[b]	.39	103
Thailand	ca. 1970	ca. .75	.75	ca. .51	77

Source: Etienne van de Walle and John Knodel, "Lessons from the Past: Policy Implications of Historical Fertility Studies," *Population and Development Review*, Vol. 5, No. 2 (June 1979) Table 1, pp. 221-222. Reproduced with permission.

Note: Country borders are of the date of decline. All figures refer to the year estimated as the date of a 10 percent decline in marital fertility except the index of the level of marital fertility before decline. Estimates were obtained by interpolation or extrapolation when data were not directly available for the year indicated.

[a] In 1831.
[b] Excluding consenual unions.
[c] Children dead after registration only.

were they available for comparison, would explain the timing of the decline. Clearly, large differences in the level of development existed among European populations at the start of their fertility transition and it seems safe to conclude that there was no easily definable threshold of social and economic pro-

Percent of male labor force in agriculture	Percent rural[d]	Percent in cities over 20,000 population	Percent illiterate[e]
70	81	7	High
30	56	22	30
33	78	9	Low
38	68	21	Low
73	84	11	49[f]
15	28	57	Low
49	81	11	Low
13	27	49	Low
29	26	42	Low
42	61	23	Low
37	72	18	Low
40	—	19	21
66	85	9	44
46	38	28	39
70	82	7	60
66	45	26	46
48	73	20	Low
58	66	20	14
47	42	31	30
37	29	53	15
75	85	12	18

[d] In communities of fewer than 5,000 or legal definition.

[e] Both sexes, aged 10+ or 15+; high refers to percentages of young adults unable to sign their name on the marriage certificate or of illiterate army recruits, exceeding 50 percent; low refers to percentages under 10 percent.

[f] 6+

gress required for it to begin.

Table 8 also shows infant death rates in the various countries at the time the fertility decline took hold. The increased survival of young children has often been singled out as a decisive factor in influencing parents to reduce their fertility when they come to realize that it takes fewer births to obtain a desired number of surviving children. Table 8 reveals, however, that the fertility decline in Europe began under a wide variety of infant mortality conditions. In many countries the decline in fertility either preceded, or began at the same time as, the decline in infant mortality. Recently, the role of infant mortality in the fertility transition has been thoroughly reappraised.[38] During the 18th century and for most of the 19th century, infant mortality declined slowly in some countries as a result of improved living conditions. But in the last quarter of the 19th century, both marital fertility and infant mortality fell rapidly at the same time. It may be that the ability to determine a target family size through family limitation was a preliminary condition to any real progress in infant and child survival.

The four examples of recent fertility decline in developing countries presented in Table 8 show a diversity in socioeconomic development and infant mortality similar to that of the European countries when their transition began in the 19th century. Thailand, for example, was still 85 percent rural about 1970 when its marital fertility was recorded as having fallen 10 percent below a peak level while Chile was less than 30 percent rural in 1964 when its fertility transition began. However, Chile's infant mortality rate was still at a high 103 deaths per 1,000 live births in 1964, in contrast to the comparatively low level of 49 annual infant deaths per 1,000 live births which Taiwan had reached at the start of its fertility decline in 1963. And in the developing world today, there are still countries that are considerably more industrialized and urbanized and have lower illiteracy and infant mortality than many 19th-century European countries, but where marital fertility has not yet started to decline.

Cultural Factors in the Decline

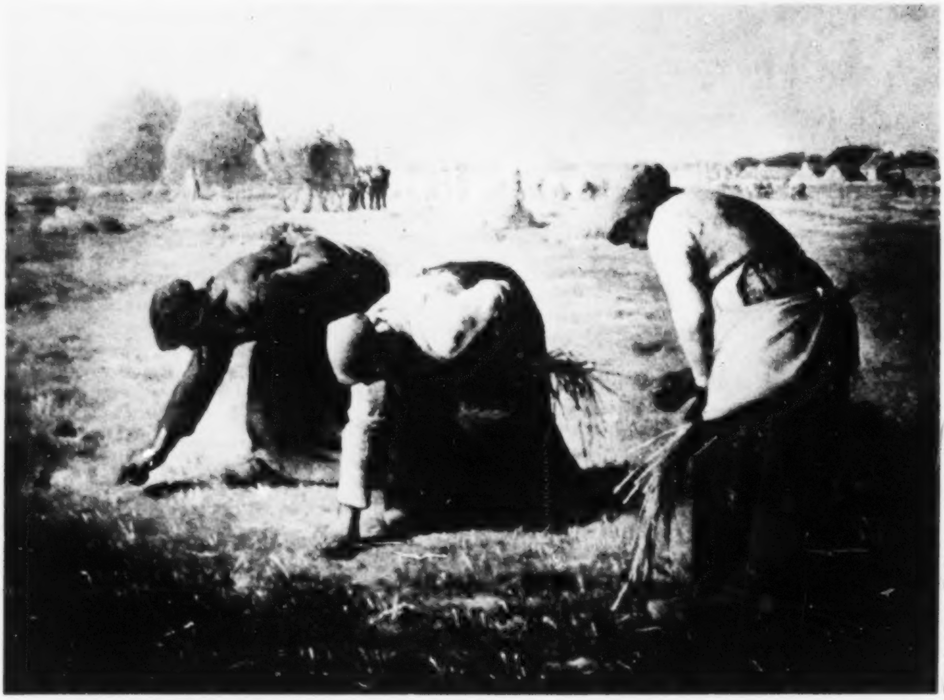
If the simultaneous onset of the fertility decline in European countries is not accounted for by similarity in socioeconomic conditions, then another explanation is in order. We believe that the remarkably grouped timing of the adoption of family limitation in the West can be explained by the cultural setting of countries which shared a means of communication and common standards of conduct. If this is so, the differences in the dates of fertility decline can also be explained by cultural rather than by socioeconomic factors.

A persistent finding of the recent research on Europe's fertility transition is that the onset and spread of the decline seemed to cluster regionally in a way that cannot be explained through similar socioeconomic characteristics. Fertility trends were more alike among provinces within the same region but with different socioeconomic characteristics than they were among provinces with similar socioeconomic characteristics but located in different regions. Common language, religion, or less easily documented customs are typically shared by neighboring provinces within a region whereas cultural boundaries impede the flow of information and the process of diffusion.

A recent analysis of the fertility decline in Russia underscores the importance of culture and tradition.[39] Long-standing cultural traits seem to underlie the persistence to this day of high fertility and the absence of family limitation in the rural populations of Soviet Central Asia, despite many decades of social change, universal primary education, low mortality, and massive indoctrination efforts. Although a direct connection remains to be established, the subordinate position of women, which appears to be an entrenched part of the dominant Muslim culture of the region, is probably a factor.

A striking example of the importance of language boundaries is provided by the two ethnic communities of Belgium. The French-speaking Walloon areas had an earlier and faster fertility decline than the Flemish areas. Moreover, physical proximity was of no importance in places where the two cultures met. An examination of a sample of paired villages, only ten kilometers apart but on opposite sides of the linguistic boundary, reveals that although there were no significant social and economic differences between them, the language border constituted "a real demarcation line between two obviously non-interacting demographic regimes."[40] In England, by contrast, a close communication network, combined with cultural homogeneity, made for almost simultaneous acceptance of family limitation throughout the country despite widely varying levels of urbanization and economic development.

The diffusion of the idea of family limitation was an essential component of the fertility transition, and best explains such characteristics as its suddenness, irreversibility, and simultaneity. If diffusion was involved rather than independent invention of family limitation by individual couples, stimulated by socioeconomic change, then the ease of communication within a cultural sphere is an important factor in the timing and pace of the fertility decline. It is probably wrong to assume that the decline was triggered by the transfer of information on birth control techniques or actual contraceptive devices. Some diffusion of techniques clearly occurred among interested couples but this would have been too secretive and too subject to censure to have been responsible for the very fast drop of fertility in millions of individual families. The decisive factor was probably the spread of a new mentality—an openness to the idea of manipulating reproduction, a new willingness to explore methods of fertility control, or the new acceptability of already available methods which previ-


The Louvre, Paris

"The Gleaners" by Millet. French peasants were forerunners in family limitation.

ously seemed scandalous, uncouth, or threatening to the sexual prerogatives of the male.

What happened in England is most often cited as evidence of this diffusion process. There, in 1877, Charles Bradlaugh and Annie Besant decided to reissue a pamphlet entitled *The Fruits of Philosophy* written 44 years before by an American, Dr. Charles Knowlton, advocating douching as a contraceptive method. Until then, the pamphlet had been selling at an average of a few hundred copies a year; now the authorities unaccountably decided to prosecute for its publication and sale. Bradlaugh and Besant meant their action as a deliberate provocation, and the publicity attending their trial fully justified their expectations. They were given a national tribune to state the case for family limitation and some 125,000 copies of the pamphlet sold in three months. Hower, it is pointed out, the trial may have been only a conspicuous episode in a movement that had already begun:

> "The extensive publicity which the press had unwittingly provided brought the idea of contraception vividly to the minds and thoughts unaffected by the earlier propaganda. . . . If the trial can with truth be said to have jolted the nation into a new awareness of the birth control doctrines, its influence must not on that account be overemphasized. The fact that the reports of the proceedings found a public in some respects already prepared would suggest that forces other than the trial itself were at work to modify traditional beliefs. For this reason the widespread publicity given by the press may be more correctly regarded as the accelerator of a process already begun than as an indication of social change."[41]

Thus "birth control doctrines" were diffused if not necessarily the particular method (douching) advocated by Knowlton. And since family limitation was spreading at that very time all over Europe, the tremor attending the Bradlaugh-Besant trial must have been more a symptom of the timeliness of the idea and of the receptiveness of the public than a main factor in spreading the doctrines.

The diffusion occurred within an existing social framework and encountered resistance from the established powers of the day. In the Bradlaugh-Besant case, the resisters were the English judiciaries. Later, as the 20th century began, the U.S. Post Office assiduously hunted down birth control propaganda as "lewd and obscene." Everywhere the political, moral, and religious defenders of motherhood and apple pie condemned birth control as scandalous and deplored the decline in family size—at least in public. Hypocrisy and double standards were common even after the transition was well under way. At the time the 1921 French law prohibiting birth control propaganda and the sale of contraceptives was passed, an opposition newspaper pointed out that members of the French National Assembly who voted for the law had themselves overwhelmingly opted for small families.

The identification of social and cultural indicators that reflect a receptivity to family limitation has lagged behind the measurement of more readily identifiable socioeconomic characteristics. Nevertheless, such hard-to-measure factors as changes in the status of women, secularization of attitudes, and the rejection of societal traditions in favor of individual interests may have played a more important role than socioeconomic factors in setting off the West's fertility transition.

Lessons for Today's Developing Countries

There is universal agreement that the demographic transition is now under way throughout today's developing world in that death rates have fallen virtually everywhere. Although generally the rates still compare unfavorably with those of developed countries, the improvements that have occurred, especially since World War II, are truly spectacular compared to any past experience. In most developing countries, mortality has declined far faster than it did in the West, but in both cases the process has been largely irreversible, at least to date.

The focus of this *Bulletin*, however, is on fertility decline and here there is less agreement concerning the path the Third World is following. In almost all developing countries, birth rates are still higher, and often substantially so, than they are in developed countries. In 1977, birth rates still averaged 35 per 1,000 population in Latin America as a whole, for example, and 46 per 1,000 in Africa, compared to 12 in Western Europe, 15 in the U.S. and Japan, and 18 in Eastern Europe.[42] However, there is mounting evidence that fertility has begun to fall in an increasing number of developing countries.[43] And, as with mortality, this decline once begun is often far more rapid than it was in the West.

Thus the demographic transition appears to be maturing in a substantial number of developing countries and doing so at a pace unprecedented in the historical experience. Still there are enough developing countries where fertility has shown little or no trend toward sustained decline to leave open the question of whether they will necesarily follow the pattern of the past. Indeed, questions can be raised about whether even the recent mortality declines in these countries can be sustained much longer in the face of deteriorating living conditions caused by the rapid population growth which stems from the current imbalance between low death rates and high birth rates.

Differences and similarities

There are differences between today's developing countries and Western countries prior to their fertility decline that are far from trivial and their implications for the demographic transition in the Third World should not be minimized.[44] In Western Europe especially, population growth rates (the difference between birth and death rates) never came close to the staggeringly high levels that have characterized many less developed nations in the past two or three decades. The reason for this important difference is two-fold. First, although marital fertility during the predecline period was as high in the West if not higher than it has been for today's developing countries, overall birth rates were substantially lower due to the late age at marriage and large proportions who remained permanently single. Second, since death rates did not decline as fast, they were generally higher in the West at equivalent stages of the demographic transition than they are or have been in less developed countries. For example, in Sweden in 1855, about 40 years before its long-term fertility decline began, the birth rate was 33 per 1,000 population and the death rate 22 per 1,000. This makes for an annual growth rate of 1.1 percent—a rate at which a population doubles in 63 years. For Taiwan in 1953, ten years before the 1963 date established for the onset of its fertility transition (see Table 8), the birth rate was 45 and death rate 9 per 1,000.[45] The resulting 3.6 percent growth rate, if continued, would have doubled Taiwan's population in just 19 years. The unique marriage pattern which kept predecline fertility moderate was crucial to Western Europe's preindustrial demographic situation and was itself a product of social and economic norms which are generally not found in Third World countries today.[46] Despite these and many other important differences, however, we believe there are fundamental features of Europe's historical fertility decline that are relevant to understanding the current situation in less developed contries and particularly to judging the potential contributions of family planning programs in precipitating or accelerating fertility decline.

To recapitulate these features. They include the variety of social, economic, and demographic conditions under which Europe's fertility transition took hold; the remarkable concentration of the starting dates; the absence of deliberate birth control within marriage before the decline despite evidence that a substantial proportion of births were unwanted; the apparent coincidence of the decline with the sudden adoption of family limitation practices; the rapid spread of such practices, once they appeared; the resultant drastic change in reproductive behavior; the irreversibility of the process once under way; and, finally, the importance of cultural factors among those that appeared to influence the onset and spread of the fertility decline. These same features can be identified in many less developed countries today.

Fertility has already fallen decisively in Third World countries at quite different levels of development (at least as measured by conventional socioeconomic indicators). They include not only the relatively well educated and completely urban city states of Hong Kong and Singapore, and countries with spectacular economic success such as Taiwan, but also countries with more moderate economic growth that remain predominantly rural, such as Thailand and even Indonesia which is clearly among the poorest nations in the developing world. The onset of these fertility declines is also quite concentrated in time; many began in earnest only during the last decade and a half. Thanks to a large number of sample surveys, we have direct evidence for many of these countries that birth control knowledge was lacking in the predecline period.[47] The surveys also indicate that desired family size was often below the actual number achieved which suggests that much fertility was unwanted. Further, the surveys document the rapid and apparently irreversible adoption of birth control within marriage in these countries once it starts to be practiced by any sizable proportion of couples.

As we have already seen in comparing Taiwan with Sweden (Figure 9, page 27), reproductive behavior is being transformed in many present-day developing countries through the same process of family limitation as in the West. The same irreversible increase in family limitation is evident in both countries and, as with Sweden, a steady reduction in marital fertility has accompanied the increasing practice of family limitation in Taiwan. The striking difference is not in the trend but in the pace. Just as mortality declined far faster in developing countries than in the West, the shift from high to low fertility and the accompanying transition from natural fertility to family limitation, at least where it is now taking place, are occurring at a speed unprecedented in the past. The process is similar; the pace is different.

Also like the West, cultural boundaries seem to dictate the onset and spread of fertility decline in the Third World. This is true both on an international basis and for ethnic communities within the same nation. Moslem and Sub-Saharan African countries, for example, typically lag behind other less developed countries in fertility decline even after other relevant factors are taken into account.[48] In Singapore and Malaysia, birth rate declines began later among Malays than in the ethnic Chinese and Indian groups. However, in Singapore, the lag was only from 1958 to 1965.[49] Thus, again, the underlying process seems similar but the pace faster.

Policy implications

Given these similarities between the past and present fertility declines it seems appropriate to ask what implications for population policy in Third World countries can be drawn from the historical record. One finding we have stressed is that there is only a loose relationship between the level of socioeconomic development and fertility decline. Although a relatively high level of development may often accompany a fall of fertility, it is clearly not a precondition. Thus, the introduction of a family planning program in a developing country at an early stage of development does not necessarily foreclose its success. After all, the initiation of fertility decline based on voluntary use of relatively inefficient means of fertility control occurred in some European populations at a time when their level of socioeconomic development was remarkably low.

A related finding is that there appears to have been an important innovation-diffusion dimension to the reproductive revolution that swept the West. If family limitation was an innovation in Europe when the fertility transition began and its diffusion contributed to the pace of fertility decline there, the same process can occur in developing countries today, where family planning also represents a new type of behavior. Organized family planning programs that provide both information and services, as well as propaganda efforts designed to legitimate family planning practices, may well help initiate or accelerate the adoption of these practices. The "legitimation" function of a government or privately sponsored program may be of considerable importance if existing birth control techniques are primarily associated with extramarital sex, as they appear to have been for a long time in Europe and reportedly still are in some less developed countries today. Moreover, given the modern communications now existing in much of the developing world, the potential for rapid diffusion of birth control practice is considerably greater than it was historically.

The irreversibility of the spread of family limitation and the decline of fertility in the past clearly contradicts the assumption sometimes made that family planning programs in today's developing countries can only skim the cream off the top and that, after initial success, demand for their services will dry up.[50] The historical record suggests that, once started, the decline of fertility does not easily stop.

If it is true that women in pretransition Europe would probably have been more receptive to birth prevention than their husbands, then the methods of birth control available are also of some importance. The argument that withdrawal is always an option not only ignores the real possibility that it may be unknown or culturally unacceptable, but also overlooks the possibility that it may be the wife who is most interested in preventing births. The fact that a variety of modern methods are promoted by family planning programs today, including many female methods, such as the pill, IUD, injection, and tubal ligation, should contribute to an acceleration of fertility decline.

Whether or not a family planning program will meet with success will be determined by how receptive couples are to the idea of reducing their fertility once the knowledge and means of birth control are available. The absence of practice prior to campaigns to disseminate information and services does not necessarily indicate the lack of such receptivity. It may instead reflect an unfamiliarity with the concept and methods of family limitation.

Unfortunately, our knowledge of what determines couples' receptivity during the early stages of the transition to low fertility is quite incomplete. It seems reasonably clear that is is only loosely linked to the level of socioeconomic development as conventionally defined. Thus the mere attainment of a certain threshold of socioeconomic development appears an uncertain predictor of the trend of fertility. Apparently the level of development necessary to provoke a change in reproductive behavior is so variable that there is no telling, except after the fact, whether modernization was advanced enough for fertility to decline. Thus, the historical record provides little assurance that efforts to reduce fertility or hasten a decline through raising the level of socioeconomic development will meet with early success.

UNICEF photo by Na Pombejr

A family planning fieldworker makes her rounds in Thailand where fertility has fallen decisively although the country is still predominantly rural.

One of the more important implications of our interpretation of the historical record, then, is that current recommendations to shift the emphasis away from family planning programs and toward development efforts as a means of reducing fertility should be viewed with considerable caution.[51] Stressing the importance of general development programs or the selective restructuring of such programs at the expense of programs aimed at disseminating both knowledge and methods of birth control is politically popular at the moment.[52] Our interpretation of the historical record, however, casts doubt on the assumption that such shifts in policy will often be expedient in hastening declines in birth rates. In many cases a greater payoff might well result from concentrating efforts on improving and extending existing family planning programs.

Of course, it would be unrealistic to

assume that either family planning programs or development efforts designed to influence fertility will be successful everywhere immediately, especially if no attention is paid to the long-established cultural values regulating fertility in specific societies. While family planning programs may elicit a very favorable response in some populations even at quite low initial levels of development, in others we might expect such efforts to be quite unsuccessful at considerably higher levels of development. Under the latter circumstances, it is hard to be optimistic about the potential of either organized family planning or general development efforts for lowering population growth until these cultural barriers are broken down. Family planners would be offering their message and wares to an unreceptive, even, perhaps, largely inaccessible audience (particularly in situations where women's roles are highly segregated and male domination is extreme), whereas general development programs would be most likely to increase population growth by reducing mortality while fertility remains high.

Unfortunately, there is very little firm knowledge concerning the cultural factors that have facilitated the acceptance of family limitation. However, we believe the historical record suggests that special attention should be paid to those cultural features that determine the status of women and their ability to assert their own wishes regarding childbearing. In cultural settings where the female role is subordinate to the extreme and where women are isolated from the broader communication network, policies designed to alter the status of women may be more conducive to reduced fertility than either family planning alone or more general development efforts.

Finally, the historical evidence suggests that high infant and child mortality may have been as much a reaction to high fertility as vice versa. If, in the absence of birth control, dissatisfaction with excessive fertility led to significant numbers of infant deaths through neglect or abusive child care, this suggests that high infant and child mortality rates are not necessarily contraindications to readiness for family planning programs, as has been generally assumed. Indeed, just the opposite may be true.

It would be foolish to expect that all or most of the critical policy issues of today can be effectively addressed by looking into the past experience of the West. For example, the success of organized family planning efforts depends on such programmatic factors as program content, strategy, organization, and administrative structure—factors about which the historical record cannot tell us much since the fertility transition in the West occurred while most governments, rather than enacting programs to encourage fertility decline, remained staunchly pronatalist. Nevertheless, the richness of the findings emerging from the large number of in-depth studies of the historical fertility experience now under way is impressive and we have far from exhausted their implications for current policy. Not everyone will agree with the implications we have drawn. However, we hope we have made clear that recent research has not only expanded our knowledge of the historical fertility transition of the West, but has also provided us with a valuable perspective for the study of the demographic changes that have only begun in much of the rest of the world. ☐

Footnotes

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Population Bulletin

America's Baby Boom Generation: The Fateful Bulge

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Abstract—Nearly 42 million births occurred in the U.S. from 1955 to 1964, a ten-year record unequaled to then and unlikely soon to be repeated. This *Bulletin* explores the baby boom's roots and lasting impact on U.S. society—an impact accentuated by the phenomenon's unexpected interruption of a century-long fertility decline and the relatively small sizes of the preceding Depression and following "baby bust" birth cohorts. Large families explain less of the baby boom than commonly thought. Demographically, the main cause was a near-universal rush into early marriage and formation of families of at least two children. This was fueled by favorable economic conditions for the relatively scarce young men of the Depression cohort then entering the job market and a revival of pro-marriage, pronatalist norms long present in U.S. culture. To accommodate the outsize baby boom cohort, school and college facilities expanded enormously in the 1960s and early 1970s and are now too abundant for the current school-age baby bust cohort. Similarly, unemployment and crime rates rose and subsided with the passing of the baby boomers through late teenage and early adulthood. In the 1980s, with the bulk of baby boomers aged 20-30, housing demand will remain high and annual birth *numbers* will increase even if the *rate* of childbearing hovers below replacement level at about 1.8 births per woman as it has since 1974. Per capita earnings and overall labor productivity should improve as the baby boom cohort settles into experienced middle age in the 1990s, although advancement chances will be limited for the cohort's members. U.S. society's greatest baby boom challenge will come as the cohort reaches retirement age; the 65-and-over population will nearly double from 31 million in 2000 to almost 60 million in 2030. The ratio of active workers paying into the Social Security pool (the baby bust cohort) to elderly beneficiaries will fall drastically although the burden will be offset somewhat by reduced proportions of young dependents under age 18.

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America's Baby Boom Generation: The Fateful Bulge

By Leon F. Bouvier

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POPULATION BULLETIN
Vol. 35, No. 1, April 1980

America's Baby Boom Generation: The Fateful Bulge

By **Leon F. Bouvier**
Select Commission on Immigration
and Refugee Policy

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Dr. Bouvier acknowledges the indefatigable assistance of PRB Director of Publications Jean van der Tak in the preparation of this Bulletin. *Mary Barberis, Carl Haub, and Elaine Murphy of the PRB staff also merit a heartfelt thank-you for having read through the manuscript and for making valuable suggestions, many of which were incorporated in the final version.*

Seldom does a day or week go by without the media—be it radio or television, newspapers or magazines—making reference to the "baby boom" and its impact on some aspect of U.S. society. Indeed, when it comes to U.S. population matters, the concern of a decade ago over population growth itself now appears to have shifted to anxiety over changing age patterns or the population's "age distribution." Changes in the proportion of people in various age ranges are by and large the results of changes in fertility. And it was changes in fertility that brought about the post-World War II baby boom cohort and its smaller neighboring cohorts, the Depression cohort of the 1930s and the "baby bust" cohort of the 1970s.*

This *Bulletin* focuses on the baby boom cohort or generation—its causes, its size, and most importantly, its impact on society. As it moves through life, this swollen generation creates a bulge in the U.S. population age distribution that demographers have likened variously to "a goat (or a watermelon or a pig or an elephant) passing through a boa constrictor (or a python)." "Much of our recent and future history will consist of this giant generation passing through infancy, youth, the middle years and old age," says Harvard University demographer William Alonso.[1]

The baby boom seems "explosive" only because the preceding and following cohorts were relatively small. To get a better perspective on the baby boom's impact, all three generations must be analyzed. Hospitals that rushed to accommodate soaring numbers of births in the 1950s were caught with empty maternity wards as births began to subside in the mid-1960s. Elementary schools and then high schools in their turn went through similar boom and bust sequences. And now in the 1980s, universities are being left with an oversupply of just-completed buildings and tenured faculties as the baby boomers begin to move out of the 18-24 age bracket.

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*A cohort consists of all the people born within a stated relatively short period, e.g., five or ten years.

The aging of the baby boomers followed by the thinner ranks of the baby bust generation promises some good things. The high juvenile-delinquency, crime, and unemployment rates of the late 1960s and 1970s should come down as teenagers dwindle in number in the 1980s. Inflation fueled by the soaring demand for housing should abate as the peak of the baby boom generation leaves behind the 20-30 household-formation ages. But off in the 21st century lurks the crunch that could come as this generation begins to retire and the smaller following cohorts are left to finance their Social Security benefits.

What Was the Baby Boom?

In many ways, the baby boom was like a sonic boom, so startling was this unanticipated fertility increase. Simply stated, the baby boom was a "disturbance" which emanated from a decade-and-a-half-long fertility splurge on the part of American couples. This post-World War II phenomenon upset what had been a century-long decline in the U.S. fertility rate. Upon completion of this extraordinary period of family formation, the fertility rate once again resumed its long-term decline and recently attained a record low point.

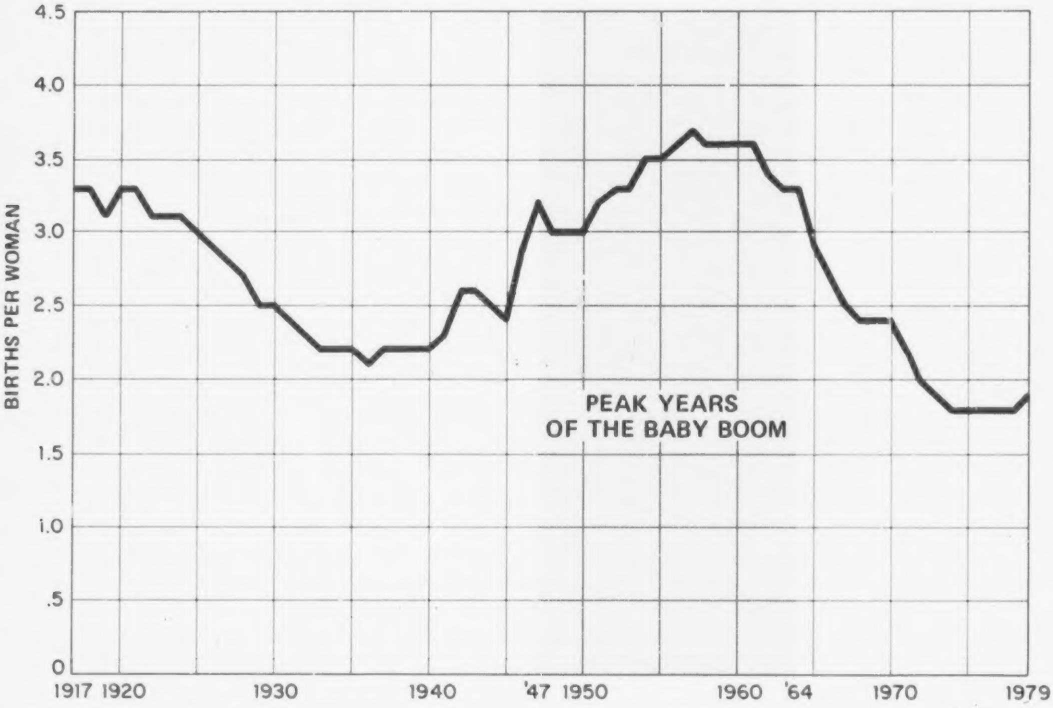
A few other countries also participated in this fertility rite. Canada's fertility trends and those of Australia and New Zealand are remarkably similar to the experience of the U.S. But the phenomenon did not occur in the developed countries of Western Europe, nor in the centrally-planned nations of Eastern Europe. In most instances, fertility increased for a few brief years after the end of World War II and then returned to the low levels prevalent prior to the war.

U.S. demographers were caught short. Most were prepared for a brief postwar spurt in annual births but not the protracted surge that followed. Indeed, in the 1940s, demographers were predicting that the U.S. population would soon stop growing at a size far below the numbers we now have. Demographers Warren Thompson and Pascal Whelpton predicted in 1943, for example, that the 1970 figure would be 157 million and that the nation's population would peak at 161 million in 1985 and then begin to decline.[2] The figure in 1970 was, in fact, 204 million and in 1985 is likely to be 230 million and still growing at close to 2 million a year.

The mistaken forecasts of the early 1940s were based on more than simple extrapolation of past trends. They stemmed also from what was then (and still) accepted sociological theory. With increasing urbanization and "modernization" would come a shift from a traditional to a rational way of life. And with a rational way of life, it was held, women would be freed from the bondage of the home, individualism would flourish, family functions would be taken over by specialized institutions, contraception would become universal, and large families would be relegated to the past.

Contrary to popular opinion, the baby boom did *not* represent a return to the large family of the 19th century. What actually happened, as demographer Charles Westoff puts it, was "a movement away from spinsterhood, childless marriage and the one-child family, and a bunching together of births at early ages. Only a minor part of the baby boom can be attributed to increases in the proportions having three or more births," he claims.[3] The pro-

Figure 1. Total Fertility Rates for U.S. Women: 1917-1979



Sources: 1917-75: Selma Taffel, *Trends in Fertility in the United States*, Vital and Health Statistics, Series 21: Data from the National Vital Statistics System, No. 28 (Hyattsville, Md.: National Center for Health Statistics, 1977) Table 13; 1976-77: U.S. Bureau of the Census, *Statistical Abstract of the United States, 1979*, Table 82; 1978: U.S. Bureau of the Census, "Population Profile of the United States: 1978," *Current Population Reports*, Series P-20, No. 336, Table 3; 1979: National Center for Health Statistics, Natality Division, personal communication, April 1980.

portion of women having at least two births rose from 55 percent in the 1930s to 85 percent in the 1950s.[4] However, the average number of children that women actually had altogether rose only from a low of 2.3 apiece (for women born in 1908) to about 3.2 (the "completed family size" that the Census Bureau calculates women born in 1935 will have averaged by the time they reach age 50).[5]

When Was the Baby Boom?

To pinpoint the period of the baby boom, both the rates and numbers of births must be considered. If we are interested in fertility behavior—the annual number of births per woman—the rates are the crucial indicators; if we are interested in societal impacts of different cohorts, then the number of births occurring in a given year is more meaningful.

To trace 20th century trends in U.S. fertility rates, we use the total fertility rate (Figure 1). The total fertility rate of a given year indicates the number of children that would be born to each woman in a population during her lifetime if each were to have children throughout her childbearing years (considered ages 15 through 44) at the same rate as women of those ages actually did in that year. It is not the same as the average completed family size, mentioned above—the number of children that women of a particular cohort *actually* had on the average by the time they

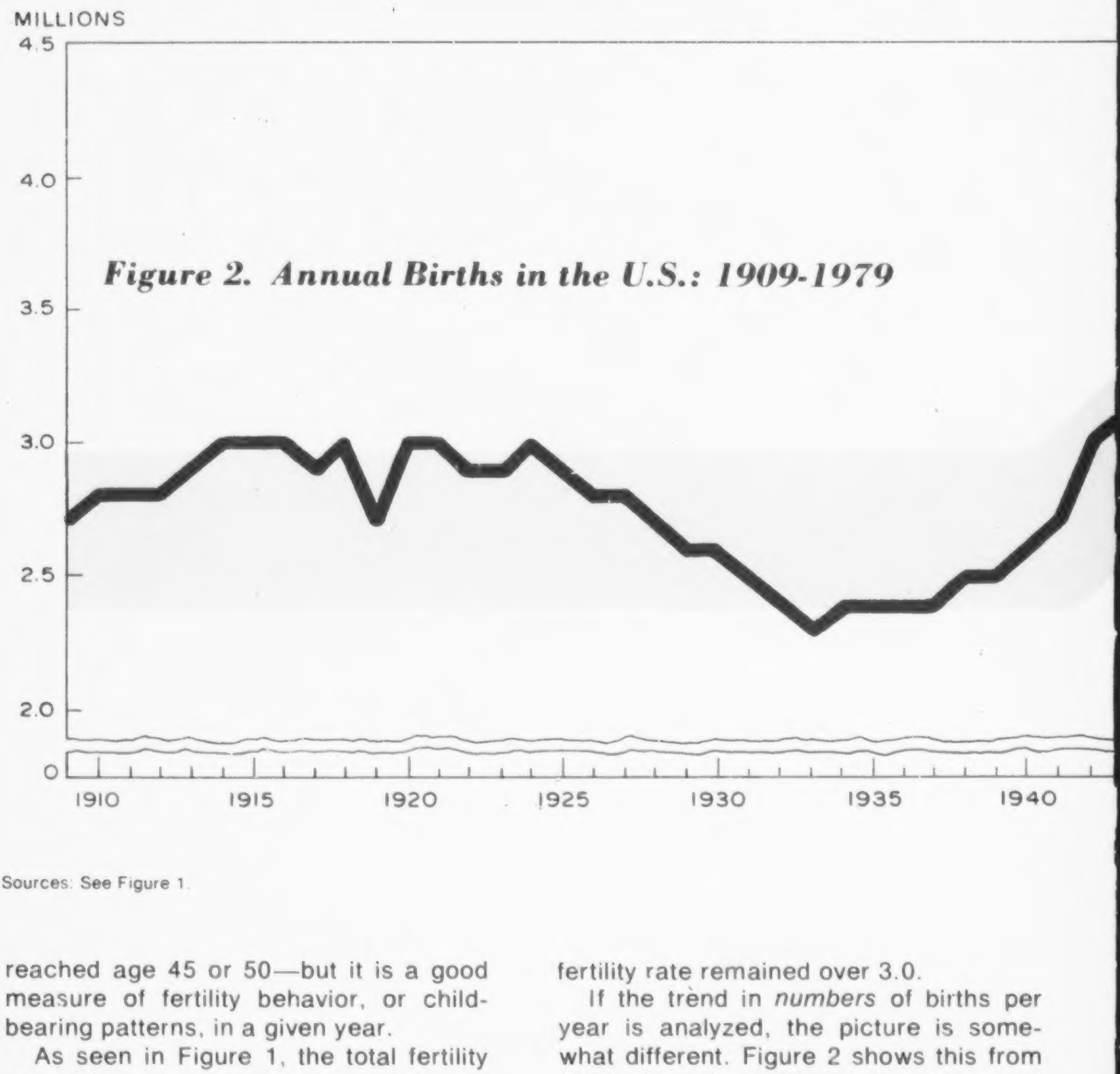


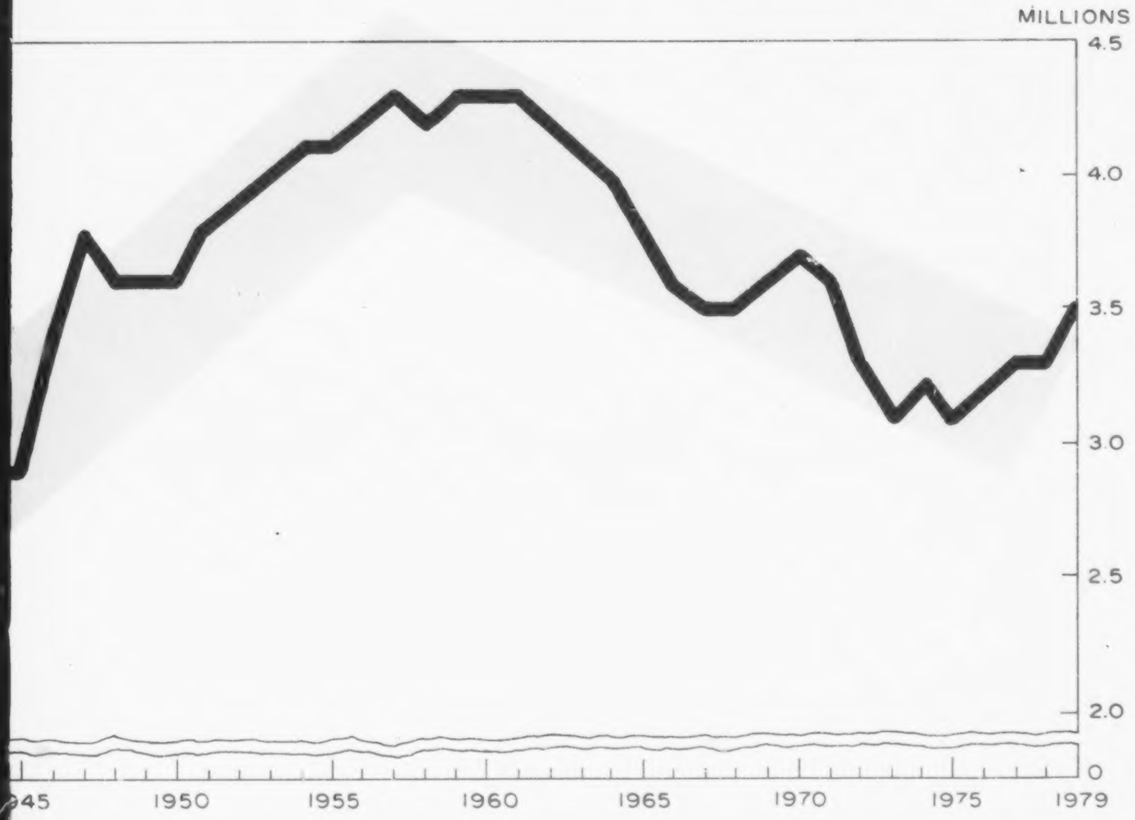
Figure 2. Annual Births in the U.S.: 1909-1979

Sources: See Figure 1.

reached age 45 or 50—but it is a good measure of fertility behavior, or childbearing patterns, in a given year.

As seen in Figure 1, the total fertility rate fell quite steadily from 3.3 per woman in 1917 to 2.1 in 1936 (with a dip during the influenza epidemic year of 1919). This was followed by a slight rise to 1943, another dip, a sharp rise in 1947 to 3.2, a leveling off to 1950, and then a dramatic increase to a peak of 3.7 births per woman in 1957. A gradual but steady decline then began and with slight modifications has continue to the present day. (The estimated 1979 rate was just under 1.9, up slightly from about 1.8 in 1978.) If *rates* are the criteria for determining when the baby boom occurred, one could say, 1947 through 1964—18 years when the total fertility rate remained over 3.0.

If the trend in *numbers* of births per year is analyzed, the picture is somewhat different. Figure 2 shows this from 1909 through 1979. Unlike the total fertility rate, annual numbers of births showed little variation before World War II. Indeed, the total in 1941 was the same as in 1909 (2.7 million). In the 37 years from 1909 through 1945, the average annual number of births was 2,747,000. In only six of those years did the number vary by more than 10 percent from that average. Twice it just cleared 3 million—in 1921 shortly after World War I and in the World War II year of 1943. During four Depression years (1933 through 1936) births fell below 2.4 million. Otherwise, annual births were extraordinarily stable



throughout the 37-year period.

After 1945, the number of annual births jumped remarkably. A million more births took place in 1947 than in 1945 and for the next 17 years the annual average was 4,035,000. At no time did the annual total vary by as much as 10 percent from that average. While the peak year was 1957 (as it was for the total fertility rate) when more than 4.3 million births were recorded, the number of births was greater from 1955 through 1964 than it had been between 1948 and 1957. In the 1955-64 decade, nearly 42 million births took place—the most ever recorded in the U.S. in any ten-year period. By the mid-1970s, births had fallen to just over 3 million per year, only slightly higher than in the early 1940s. (The total climbed back to 3.5 million in 1979.) In looking at numbers of births, then, one could say that the baby boom period was concentrated from 1954 through 1964 when over 4 million births occurred each year.

For practical reasons, in this *Bulletin*, we will rely on conventional decades to define our cohort dimensions. The baby boom, while it lasted from 1947 to 1964, will be treated as the decade of the 1950s (1950-59), implicitly accepting some spillover at both ends of the decade. The Depression cohort are the people born in the 1930s (1930-39). The baby bust cohort is that of the 1970s (1970-79). The intermediate decades are transition periods; the 1940s being on the rise toward the baby boom; the 1960s being on the decline to the baby bust.

Reasons for the Baby Boom

Any attempt to explain the baby boom must turn to several types of reasons: economic, sociological and psychological, as well as demographic. Labeling the phenomenon the "post-World War II baby boom" suggests erroneously that its prime cause was the end of hostilities when troops returned home, some to their wives and others to fiancees. Marriage rates skyrocketed immediately after the war (as did the divorce rate) and family formation was hurried to compensate for years of separation. This explains the first very short period of high fertility as it does the postwar boomlet in European countries. But after the spurt of 1947, both the rate and number of births fell off for the next three years. It was not until 1951 that the real baby boom got under way. Postwar family reunification and/or formation does not explain the high fertility that lasted for well over the next decade. As Donald Bogue notes, "the peak rate [in 1957-59] was achieved 11 to 13 years after military demobilization and the other dislocations associated with World War II."[6] Reunification after the Korean War which drew over six million American men away from home in 1950-53 could well have contributed to the soaring fertility of the mid-1950s, but that too was over long before the baby boom subsided.

Demographic factors

As noted, a dramatic rise in large families does not explain the baby boom, although the proportions of women having three or more children did rise. For example, close to 60 percent of women born in 1935 who were in the prime childbearing ages during the baby boom had had three or more births by the time they were 39 compared to just 32 percent at that age among Depression cohort mothers born in 1908.[7] Demographically, however, the primary causes of the baby boom were more people marrying and having at least two children at earlier ages, and also what may have been some "makeup" births among older women who were previously childless. The total fertility rate did remain above 3.6 per women from 1956 to 1960—extraordinarily high for a developed nation and 60 percent higher than that recorded in 1940. But the total fertility rate is a synthetic measure which is affected by the *timing* of births. No cohort of American women born in this century has actually had an average of that many births per woman.

This timing peculiarity is revealed in the total fertility rate for *first* births among white women during the baby boom. Between 1947 and 1957, that rate was almost always above 1, indicating more than one first birth per woman—clearly an impossibility for any real cohort of women. This anomaly reflects the overlapping of two age patterns of childbearing. First-birth rates were very high for older women as well as for younger women during this period.[8] Older women were also rushing into motherhood, but it was the younger women who made the most difference.

For them, marriage came sooner than it had for their mothers or would for their daughters. In 1956, women's median age at first marriage stood at just over 20—down from 21.3 in 1930. In other words, half of all women marrying for the first time in the early part of the baby boom were teenagers. In 1960, at the height of the baby boom, nearly three-quarters (71 percent) of women aged 20-24 were or had been married compared to barely half (51 percent) 19 years later in 1979.[9]

Babies came sooner and faster. Half of the first births to women who married between 1955 and 1964 came within 15 months after marriage, an interval only about half as long as that for women married during the 1930s (25 to 26 months) or those married in the early 1970s (27 months).[10] And during the

JUST MARRIED

Marriage was popular and early during the baby boom era.

1950s, women had their second births by age 24.7 on the average—down from age 27.1 in the 1930s.[11] Childlessness was also much rarer. In a 1975 national survey, only 8 percent of women who had married during the heart of the baby boom, 1955-64, reported themselves as still childless, compared to 16 percent of those married in the 1930s.[12]

What caused this headlong rush into marriage and parenting among young American women—behavior so different from that of their mothers a generation earlier and their daughters now?

Economic causes

For some economists, the answer seems straightforward. The U.S. economy expanded rapidly after World War II, first carried along by the stimulus of the war itself and later by the enormous expansion in transportation, housing, and government spending associated with the growth of metropolitan areas. Demand for labor was high and the supply available to fill it—young people age 15-29 just entering the job market—came from the relatively small birth cohort of the 1930s. Younger workers also enjoyed an advantage over older workers because secondary schooling had expanded rapidly between 1920 and 1940. Thus encouraged by good jobs with relatively high wages and the prospects of rapid promotion, young men were quick to marry and start families. The GI bill and Veterans Administration financing for housing also made it easy for veterans to get an early start at family-building. Young couples swarmed to the expanding suburbs with their three-bedroom homes, each with a private lot safe for small children. Further, raised in the relative deprivation of the Depression years, these young couples had not developed "tastes" for such luxury consumer items as a second car or a summer home. Extra income might well go into an extra child or two.

Economist Richard Easterlin, a leading proponent of this explanation for the baby boom, sees this same set of conditions, but this time in reverse, operating to explain the downturn in fertility during the later 1960s and 1970s. But by the late 1980s young adults (the forerunners of the baby bust generation) will again be relatively scarce, thus boosting the job and earnings opportunities of young men relative to older male workers over what they were for their baby boom counterparts. And this will touch off another round of early marriage and family formation and a rise in the birth rate, Easterlin predicts.[13]

Sociological causes

Sociologists have a different explanation for the baby boom. For them the key lies in pervasive pro-marriage, pro-housewife, and pro-natalist forces that have always been woven into American culture and which somehow resurfaced after the Depression years and World War II when young women had gone to work—and college—in large numbers and at least dreamed of having a career. Betty Friedan called it the "feminine mystique" in her 1963 book that helped fertilize the rebirth of feminism in the U.S.—the women's liberation movement.

Describing women's lives in the 1950s, she wrote:

> ". . . kitchens were once again the center of women's lives. . . . Girls were growing up in America without ever having jobs outside the home [and although] a third of American women now worked, most were no longer young and very few were pursuing careers. They were married women who held part-time jobs, selling or secretarial, to put their husbands through school, their sons through college, or to help pay the mortgage. Or they were widows supporting families. Fewer and fewer women were entering professional work. Shortages in the nursing, social work, and teaching professions caused crises in almost every American city. Concerned over the Soviet Union's lead in the space race, scientists noted that America's greatest source of unused brain-power was women. But girls would not study physics: it was "unfeminine." A girl refused a science fellowship at Johns Hopkins to take a job in a real-estate office. All she wanted, she said, was what every other American girl wanted—to get married, have four children, and live in a nice house in a nice suburb."[14]

The "feminine mystique" that lured almost all women into early domesticity and parenting was the conviction that the proper and only truly fulfilling role for a woman was as wife and mother. Parenthood is also a precondition for the male role, this view holds, but as a father, the male is primarily a complement to the mother—"extra-familial, protective, economically supportive."[15] Women's magazines spread the revived gospel of parenting and "togetherness." Freudian psychology, sociological "functionalism," and Margaret Mead provided the scientific underpinnings.

Freud's influence was rising to a crescendo in the 1940s and 1950s and Freud had believed that women were compelled to compensate for the lack of a penis by having children. As demographer-sociologist Judith Blake puts it:

> "Freudian psychology, from Freud to Deutsch to Erikson, is invariant in its insistence that the reproductive capacity must be actualized for the woman to approach mental health. Motherhood is what women do and they should not be encouraged to embark on social roles that conflict with the realization of their basic psycho-biological needs."[16]

Borrowing from biology and based on observations of primitive societies, social scientists in these years also began stressing that the proper functioning of the family—its "reproductive efficiency"—required that women assume the internal, nurturing role and men a task-oriented, external, supportive role. Family-life education became the fashion.

So did Margaret Mead Ironically a leader in the later "feminine protest" and a profound influence on American women for three generations, Margaret Mead was an early functionalist. "Glorification of women in the female role, as defined by their sexual biological function" permeates her prolific writings beginning with *Coming of Age in Samoa* in 1928, although this is often confounded by the opposite message that "woman's potential is as great and various as the unlimited human potential."[17] The theme is most pervasive in *Male and Female*, published in 1955, her book which Friedan calls "the cornerstone of the feminine mystique."[13]

Unwanted fertility

Another reason for the baby boom often given by demographers is the ambivalence of couples toward preventing that "extra" third or fourth child and consequent carelessness or inefficiency in practicing contraception.

We now know that large families were less common during the baby boom than has been supposed. But surveys of the time suggest that most couples wanted at least three children. Married women of childbearing age queried in a series of national fertility surveys reported an average wanted or desired family size of 3.4 to 3.5 in 1955, 3.6 to 3.7 in 1960, and 3.3 in 1965.[19] Demographers have become skeptical of generalized questions on "desired family size." A better measure of attitudes toward numbers of children is whether or not each pregnancy was wanted at the time it occurred. Questions about each of the repondents' births in turn using this approach were used in Princeton University's National Fertility Studies of 1965 and 1970. According to Norman Ryder, co-director of the studies with Charles Westoff, "The answers reveal a great deal of unwanted fertility in the 1950s, despite the stated levels of desired family size."[20]

In his view, two children has been the "fixed" norm for American couples in the 20th century and "all people are expected to marry and have [these] two children as soon as their economic circumstances permit." Economic conditions were unfavorable for fulfilling this norm in the 1930s and favorable in the 1950s. Having had two children early, young mothers of the 1950s faced "a long exposure to the risk of unwanted fertility." They felt little economic pressure to enter an unfamiliar work world and thus were likely to be ambivalent about the desirability of "yet another child" and apt to "relax contraceptive vigilance."

The National Fertility Studies revealed that the downturn in married couples' fertility during the 1960s was due almost entirely to a reduction in unwanted or "unplanned" births. Between 1961-65 and 1966-70, the "marital total fertility rate" fell from 3.82 to 2.91 births per woman. The decline in unplanned births accounted for 84 percent of that change; the drop in planned fertility for only 4 percent.[21] This decline was clearly due

Women's lives centered on family and home.

largely to rapidly increasing use of the highly effective contraceptive methods introduced or popularized in the 1960s: the pill, IUD, and sterilization.

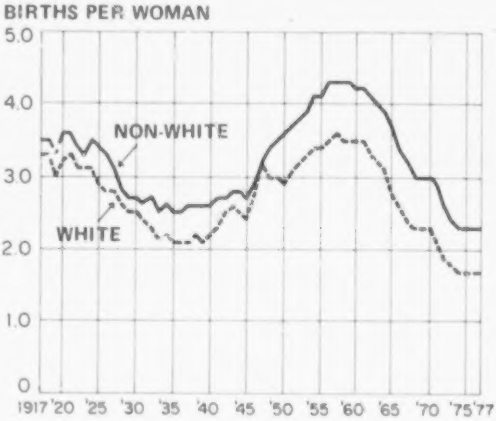
In 1965, as the baby boom waned, 67 percent of married U.S. couples were regular contraceptors. Of these, a third were using the pill or IUD or had been sterilized. Ten years later the figures were: nearly 80 percent using contraception and close to three-quarters of these using the three most effective methods.[22] Women seeking to prevent unwanted births in the baby bust era have also had the option of legal abortion that was unavailable to their counterparts in the 1950s. Legalized in some states beginning in 1967 and nationally in 1973, legal abortions have climbed from 744,600 in 1973 to an estimated 1.4 million in 1978.[23]

Who Produced the Baby Boom?

Just about every sub-group in American society contributed to the baby boom—rich and poor; white and black; Christian and Jew. But some, such as blacks and Catholics, were more involved than others.

Fertility trends among American blacks have virtually paralleled those of whites but always at a higher level.[24] As with whites, fertility among blacks had fallen to historic lows in the 1930s. In 1936, the total fertility rate for nonwhites (90 percent of whom were black) was only 2.5 births per woman. (The rate for white women reached its prewar low point in the same year at 2.1.) By 1956-58 it had peaked at 4.3 and remained close to that level until 1962 before beginning a steady fall in tandem with white fertility until the present day. In 1977 it stood at 2.3 births per women.

Figure 3. Total Fertility Rates for U.S. Non-White and White Women: 1917-1977



Sources: See Figure 1.

As can be seen in Figure 3, the effect of the baby boom was greater in the black than in the white portion of the U.S. population. Among whites, fertility actually stabilized for a few years after the initial postwar spurt in 1946 and 1947. Among blacks, however, "with the onset of the baby boom in 1946 fertility . . . rose year by year and attained a level in 1957 that it had never before exhibited in the recorded statistical history of the United States."[25] As a result, the baby boom generation represents a higher proportion of the black population than it does of the white population. In 1979, for example, Census Bureau figures show that people aged 15-24 (born in 1955-64) comprised 19 percent of the black population compared to 17 percent among whites.[26] Since young black males are more likely to be undercounted than any other group, the actual difference is probably somewhat greater.

The National Fertility Studies suggest that a much higher rate of unwanted fertility explains much of the difference in black and white fertility but the difference narrowed rapidly in the 1960s as the baby boom abated. In the first half of that decade, black married couples had three times as many unwanted births as their white counterparts and a 40 percent higher rate of fertility. By the end of the decade, the excess of black over white fertility had shrunk to 10 percent, levels of unwanted fertility were almost on a par at low levels, and a greater proportion of black wives than whites were using the pill or the IUD.[27]

Catholics are another group who were apparently affected more than average by the baby boom. Vital statistics are not available by religion, but numerous surveys taken over the years allow some general conclusions on their fertility relative to that of non-Catholics.

Fertility has traditionally been higher for Catholics than non-Catholics but all the evidence suggests that a gradual convergence took place during the 1920s and 1930s; that is, fertility fell for Catholics and non-Catholics alike, but the rate of decline was greater for Catholics. Some demographers of the day were predicting eventual equalization. A.J. Jaffe, for example, wrote: "The fertility of the Roman Catholics . . . appears to be decreasing so rapidly that by 1930 their fertility appears to have closely approached that of the non-Catholic."[28]

After World War II, however, when fertility mounted among all groups, Catholics exhibited greater gains than non-Catholics. Dudley Kirk concluded in 1955 that "the Catholic birth rate since the Second World War has reached a high and sustained level, with quite as large a differential [compared to non-Catholics] in crude rates as was recorded in the early 1920s."[29] Thomas Burch arrived at a similar conclusion in 1966: "In the U.S., recent evidence points to a persistent and even widening of the Catholic-nonCatholic differential."[30]

Unlike the black-white differential during the baby boom, the main reason for the Catholic/non-Catholic divergence appears to be that Catholics wanted more children. Catholic women who bore their children during the crest of the baby boom reported an average of 3.32 wanted births in the 1970 National Fertility Study compared to 2.55 for non-Catholics. But among younger women the differential was a narrow 2.75 to 2.35 wanted births.[31] Other evidence points to a new convergence taking place as fertility continued to decline in the late 1960s and 1970s.[32] And by 1975, almost as large a proportion of Catholic as non-Catholic married couples were practicing contraception (76 versus 80 percent) and the proportions using the pill were the same in both groups (34 percent).[33]

Thus it appears that Catholics and blacks contributed proportionately somewhat more than other Americans to the baby boom. But more important than these slight aberrations is the fact that all groups did in fact participate in the boom and in the fertility troughs that preceded and followed it. It was indeed a "giant generation" and one that will continue to pose tremendous challenges for U.S. society as it moves through its life cycle. Later sections discuss some of these challenges, but first we take a look at how the baby boom cohort and its neighbors—the Depression and baby bust cohorts—are likely to fit demographically into the nation's future.

Measuring Future Cohort Dimensions

Measuring the pre-1980 demographic impact of the baby boom is simple. One merely traces the U.S. population by age and sex through each year of the 1960s and 1970s. Determining the post-1980 *numerical* impact of the baby boom is also quite straightforward. Its members and those of the 1930s Depression cohort and 1970s baby bust cohort are already born. Following their numbers through the various stages of the life cycle is a basic demographic exercise, given the relative stability of age-specific death rates, especially among younger segments of the population.

Future immigration must also be considered, but even that number, when broken down by age and sex, is unlikely to be large enough to distort projections of the *size* of the various cohorts as they go through life.

Defining the *proportion* of the population that the baby boom cohort will comprise after 1980 is more difficult since assumptions must be made about the numbers of children that will be born in the future in order to estimate the size of the total population at any given moment. And, as is well known, fertility is the most volatile of all demographic variables. Any variation in future fertility will not affect the *number* of people in the three generations that interest us. But such variations will change the *percentage* of the total population represented by these generations.

Assumptions for population projections

Population projections necessarily stem from stated assumptions about future demographic behavior. It is worthwhile considering that, although population forecasts or predictions can be wrong, population *projections* are by definition correct (given error-free computation). They merely project figures based on certain assumptions. However, these assumptions can be—and usually turn out to be—incorrect since the future is full of surprises. The closer the assumptions anticipate what will really happen, the more accurate the projections.

The assumptions underlying this *Bulletin's* projections of U.S. total population and thus the proportions made up of our three key cohorts are as follows. It is to be hoped that they prove to be close to eventual reality.

Fertility is assumed to increase slightly from the estimated 1979 total fertility rate of 1.85 births per woman to 2.0 by 1985 and remain at that level thereafter. Some discussions of the baby boom's impact rely on the Census Bureau's Series III projection which assumes a lower fertility rate of 1.7.* The results are more dramatic. However, in 1979, the total fertility rate rose slightly above the level it had been since 1974 and there is some evidence that it may inch up for several years.

Mortality reductions have been greater than expected during recent years. Indeed, the progress noted since 1973 in life expectancy has been dramatic and unanticipated. Mortality assumptions used in the 1977 Census Bureau population projections are already somewhat out of date. In this *Bulletin*, therefore, the progress projected to occur over 100 years in the Census Bureau projections has been compressed into 70 years. That is, average life expectancy at birth is projected to reach 72.8 years for males and 82.9 years for females in 2050—up from the current figures of 69.1 for males and 77.0 for females.

Net immigration is assumed to remain at 400,000 annually in current Census Bureau projections. In 1978, however, over 600,000 people entered the U.S. legally (many of them Indochinese refugees) and an unknown number departed. Still another unknown number entered illegally and some of these have left. Accurate figures on the annual flow of illegal migration in and out of the U.S. are simply unavailable although a recent working paper prepared by Census Bureau staff for the Select Commission on Immigration and Refugee Policy suggests that the number of illegal aliens *residing* in the U.S. in 1978 ranged between 3.5 and 5 million, considerably lower than some previous estimates.[34] It seems reasonable to assume that future net immigration will be greater than 400,000 per year, especially if illegal movements are considered. Thus for this *Bulletin*, it is assumed that net immigration (the difference between people entering and leaving the country) will average 750,000 annually and that the age-sex distribution of the group will reflect that noted in recent years for legal immigrants, that is, relatively youthful and with more males than females.

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*Current Census Bureau population projections assume a gradual transition from today's fertility levels to one of three different levels. Series I, the highest, assumes that women over the long run will average 2.7 children apiece. Series II assumes a long-run "replacement-level" total fertility rate of 2.1, that is, the level of fertility that would eventually balance births and deaths if mortality remains at current levels. Series III, the low projection, assumes a long-run total fertility rate of 1.7, slightly below the rate experienced in the U.S. since 1974.

In brief, in projecting the future size and proportions of the Depression, baby boom, and baby bust cohorts, we assume a total fertility rate of 2.0 births per woman (as from 1985), average life expectancy rising to 72.8 for males and 82.9 for females by 2050, and net immigration of 750,000 per year.

Future fertility behavior will not affect the size of these cohorts, though it will affect their proportions of the population. However, both mortality and migration behavior will affect the size as well as the proportions of the three cohorts.

Demographic Impact of the Baby Boom

Population age-sex distribution

The demographic importance of the baby boom is best seen through a series of population age-sex pyramids. Figure 4 (centerfold, pages 18-19) traces the changing shape of these for the U.S. from 1960 to 2050 as our three cohorts move through life from age 0-4 (bottom of the pyramid) to age 80 and up (top of the pyramid). In 1960, members of the Depression cohort (born 1930-39) are 20 to 29 years old. Their fewer numbers cause a narrow spot in the pyramids into the 21st century. In 2010, this cohort will be aged 70 to 79. The baby boom cohort of the 1950s stands out in all the pyramids, even in old age! In 1960 that cohort forms the base of the pyramid. The large numbers it represents are noted among those 10-19 in 1970; 40-49 in 2000, and, of course, 70-79 in 2030. In marked contrast is the baby bust cohort of the 1970s. Their 10 million fewer births than those which produced the baby boom cohort are reflected in the pinched-in base of the 1980 pyramid and throughout life this cohort is overshadowed by its giant older relative—the baby boom cohort.

Cohort impact on fertility, mortality, migration

Thus far, we have concentrated on how changes in fertility have contributed to these three startingly different cohorts. Interestingly, the sharp variations in the size of these cohorts in turn affects the demographic variables themselves.

The number of births has risen in recent years (as the crude birth rate is beginning to do) and this pattern will undoubtedly be maintained throughout the 1980s. This is the so-called "echo" effect of the baby boom. By 1985 there will be 20.5 million women in the prime childbearing ages of 20-29—2½ million more than in 1975 and 8 million more than in 1965. Thus annual *numbers* of births will rise during the 1980s even if the fertility *rate* remains at a low 1.7 to 2.0 births per woman.

As the baby boom generation ages, it helps push up the median age of the population—especially if fertility remains low. This artificially raises the crude death rate, the annual number of deaths per 1,000 population. Older people are more likely to die and with more of them in the population there are bound to be more deaths. When the baby boom cohort becomes elderly, crude death rates will go up even more as some 19 percent of the population will then be 65 or over compared to 11 percent in 1980.

Young adults, usually between 20 and 30, are more likely to move than older people. Again, the baby boom and baby bust cohorts affect the overall rate of mobility. During the 1980s, the baby boom generation will be in the peak 20-30 moving ages. Migration to the Sun Belt states, for example, will probably remain high as the baby boom generation passes through the stage of life when they are most likely to change residence.

In reverse, as the smaller baby bust cohort goes through life, annual numbers of births should drop off sharply, the U.S. population may become generally less mobile, and even the crude death rate will fall when this smaller cohort reaches the oldest ages and the outsize baby boom cohort has ceased to exist. Thus, while fertility is the prime contributor to the making of these generations, these cohorts in turn, by virtue of the extreme divergence in their sizes, contribute to wide variations in fertility, internal migration, and mortality.

Impact on non-demographic variables

One glance at the population pyramids in Figure 4 reveals clearly that a country's age composition is strongly affected by variations in cohort size. In turn, many socioeconomic variables are directly affected by this age distribution. For example, crime and unemployment rates are highest among teenagers and young adults under 25 and the passing of the baby boom bulge through these stages is blamed for the upturn in those statistics in the late 1960s and 1970s.[35]

Now at the start of the 1980s, the baby boom cohort has reached the ages of 20 to 29. There are 40 million of them, comprising 18 per cent of the population—up from 22 million people and 12 percent of the population in that age bracket in 1960. Some economists see this as the explanation for the low overall U.S. savings rate of 4.5 percent and high 19.1 ratio of consumer debt to disposable income in 1979. People in their 20s and early 30s tend to earn and save less and borrow more than any other group in order to buy homes and expensive durables such as appliances, furniture and automobiles. It could also explain the much publicized recent decline in U.S. labor productivity—worker output per hour worked. With the large supply of relatively cheap young workers, employers have been able to maintain production without investing in labor-saving equipment.[36] There is no doubt that escalating inflation (up to an annual rate of over 18 percent in March 1980) is due to high current consumer demand and lower productivity, so the maturing of the extra-large baby boom cohort into the 20-29 year-old age range may be a prime factor here.

Changes in age composition affect all aspects of the business world. Demands for baby products fell off so much in the 1970s with the advent of the baby bust generation that Johnson and Johnson began pitching their advertisements to young adults, going so far as to employ professional football players as their "salesmen." Gerber Baby Foods has set up a life insurance division that boasts, "Gerbers now babies the over-50s." Insurance sales are greatly affected by age composition. A recent *American Demographics* article notes:

> "Almost one-third of all life insurance purchases are made by people in the 25-34 age group, and insureds in this age group spend more dollars on life insurance than others. Over 60 percent of those in their 30s pay more than $260 annually for life insurance, while payments below $120 per year are concentrated among the over-60 age group. In the 1980s, the bulk of the population will be in their 30s. As a result, the life insurance industry can expect sales to grow and the size of policies purchased to become larger."[37]

The U.S. divorce rate—currently among the world's highest at 5.3 per

1,000 population (in 1979)—is likely to remain high as the baby boom generation passes through their 30s and early 40s, the ages when divorce is most frequent. And when this large cohort reaches the oldest ages, the stage at which medical needs are greatest, the nation's total medical bill is likely to surge far over its current level ($192.4 billion in 1978), even accounting for inflation.

Impact on Cohort Members

While their varying numbers distort the population's age composition and thus contribute to many social problems, attention should also be given to the *individuals* who comprise the Depression, baby boom, and baby bust cohorts. How are the members of these three generations of Americans affected by being part of such small or large cohorts?

The "good times" cohort

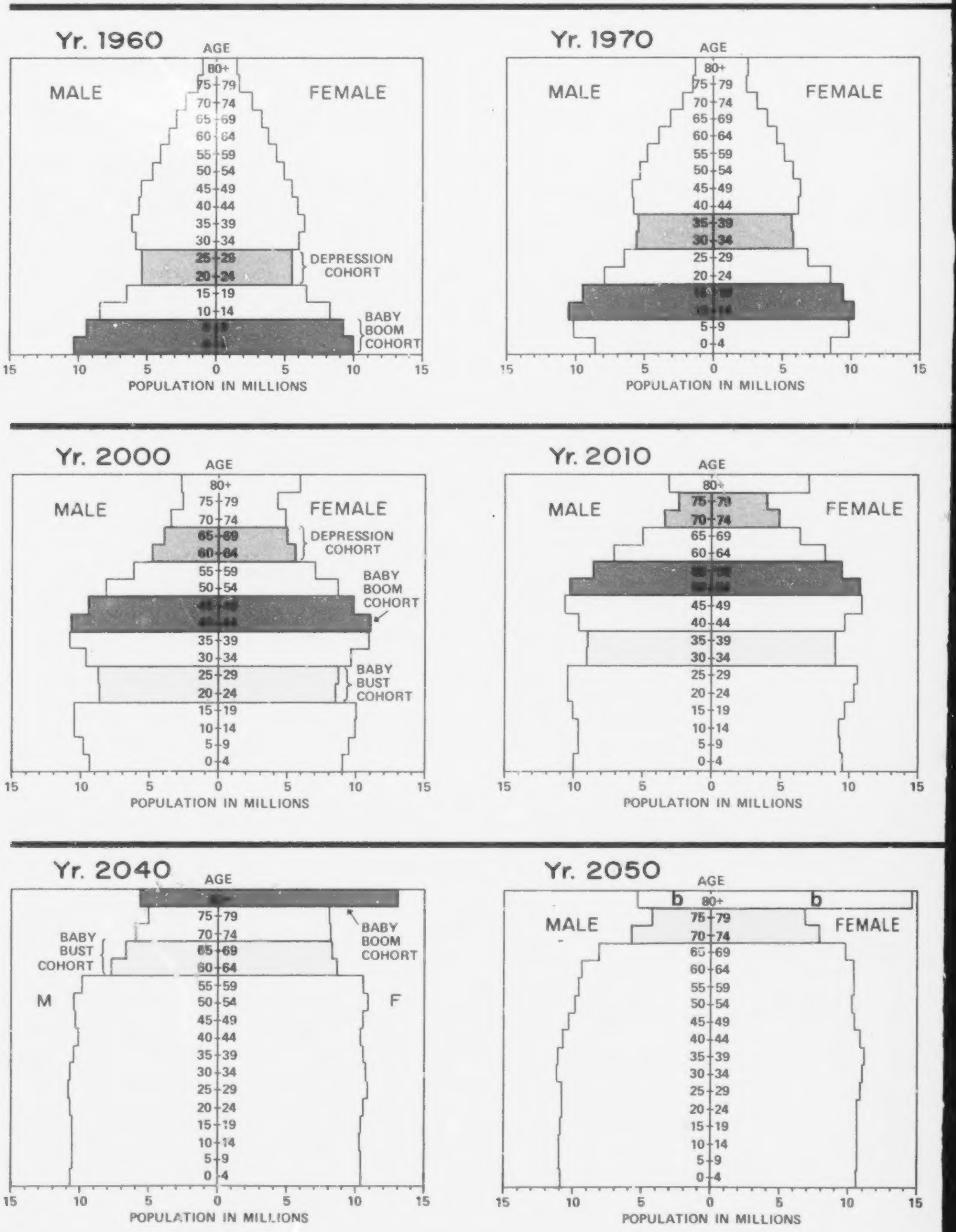
People born in the 1930s have been labeled the "good times" cohort. Although the Depression hung over their early years, this cohort has reaped the social and economic benefits of being smaller than the cohort that preceded it as well as the cohort that came after. Until the 1970s, it was the only such case in U.S. demographic history. During the 1930s, there were about four-and-a-quarter million fewer births than in the 1920s, and the good times cohort was followed by the baby boom cohort. Sociologist Carl Harter describes their advantages:

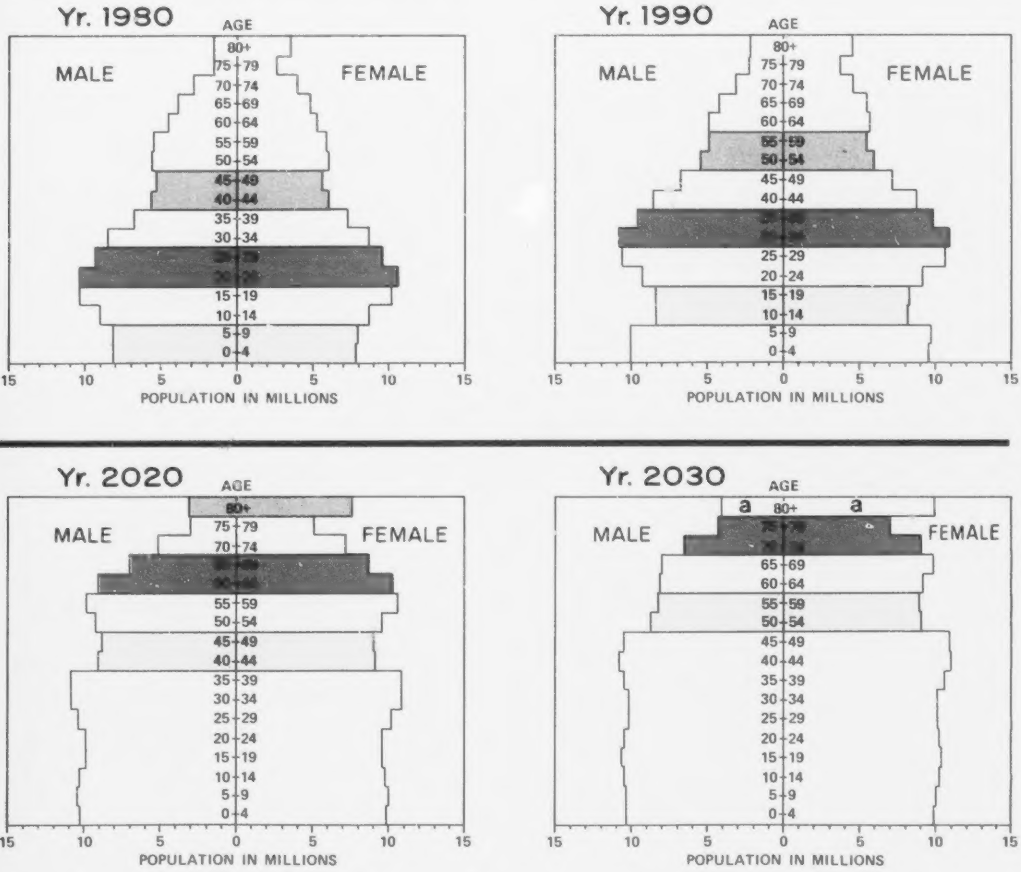
> "By virtue of their smaller number, the thirties cohort, upon encountering each important life cycle event, have experienced relative abundance—a legacy from the larger cohort that preceded them. . . . Relatively speaking, in all their important life cycle events, the 1930s cohort has 'had it made.' In 1950, when the thirties cohort was age 11-20, there were about a quarter million fewer 15-years-olds than there had been in 1940. Insofar as the number of high school classrooms, glee clubs, athletic teams, debate squads, class officers, etc., had not diminished, then the 1950 fifteen-year-old had a greater chance than did the 1940 fifteen-year-old of being in a smaller class, of being a class officer, of being a member of the glee club and athletic team and debate squad, etc. Similarly, in 1960, when the thirties cohort was 21-39 they required fewer new jobs and housing units than did their predecessors ten years earlier."[38]

The baby boom cohort

The baby boom cohort has not been as fortunate as its predecessor. Because of its much greater numbers, this group can expect problems and frustrations as it passes through the life cycle. Many are now in or just graduated from college. They have had to cope with overcrowded classrooms and teacher shortages through all their years of schooling. Many have entered the labor force, only to discover that there are not enough suitable jobs to go ground. Once employed, they will earn less relative to older workers than young workers normally do. In 1968, male college graduates aged 45 to 54 earned only 38 percent more than those 20 years younger. In 1978, the difference was up to 63 percent, largely because experienced older workers had become relatively scarce with so many younger people entering the work world.[39] Many members of the baby boom cohort are now seeking housing, which is scarce in relation to the demand and thus increasingly expensive. When they reach the peak of their employment years (30-44), there will be over one and a half times as many of them as there will be people aged 45-59. "Consequently, job advancement opportunities will be relatively fewer and competition for advancement far greater."[40] When they reach retirement age, the extra demands on the Social Security system could result in strains between the baby boom

Figure 4. Progress of Depression Cohort, Baby Boom Cohort, and Baby Bust Cohort Through U.S. Population Age-Sex Pyramid: 1960-2050





▨ DEPRESSION COHORT
PERSONS BORN 1930 – 39

■ BABY BOOM COHORT
PERSONS BORN 1950 – 59

☐ BABY BUST COHORT
PERSONS BORN 1970 – 79

Sources: 1960-1970: U.S. Bureau of the Census, *1970 U.S. Census of Population: General Population Characteristics. United States Summary*, Vol. I, PC(1)-B1, 1972, Table 52; and 1980-2050: Special unpublished tabulations prepared by Leon F. Bouvier for the Select Commission on Immigration and Refugee Policy, 1980

[a] Includes survivors of Depression cohort.
[b] Includes survivors of baby boom cohort.

Note: 1980-2050 projections assume a total fertility rate rising to 2.0 births per woman by 1985 and constant thereafter; life expectancy at birth rising to 72.8 years for males and 82.9 years for females by 2050; net immigration constant a 750,000 persons per year.

cohort and the younger persons who have to finance the system.

Clearly it will not be an easy path through the many phases of the life cycle for the baby boom cohort. "Social discontent will continue to be generated by the baby boom cohort. It seems as though wherever they are, it's raining."[41]

The baby bust cohort

The baby bust cohort of the 1970s should have a much easier passage through life. Like the Depression cohort, "Not only will there be fewer of them competing for jobs, services, and attention, but there also will have been an increase in public services and provisions made to accommodate the demands of the larger number of people that preceded them. They will be the beneficiaries of the baby boom."[42]

But this group could also be victims of the baby boom in their chances for career advancement. So many people only 10-15 years older will be employed that promotions may be a long time in coming. Demographer Conrad Taeuber suggests that middle-level positions may have to be created as "holding patterns" until the field is cleared of the older occupants of high-level jobs. Only when the baby boom cohort retires will senior positions finally be opened to those in their 50s.

All in all, however, insofar as demography shapes life chances, the baby bust cohort will enjoy an advantageous position, similar to that of the "good times" cohort. Indeed, it may be a little better off. The good times cohort was just a little smaller than its predecessor and much smaller than its successor. But the baby bust cohort is much smaller than its predecessor and will probably be a little smaller than its successor—the "echo effect" children of the baby boom.

It is clear that being a member of one of these cohorts can make a significant difference in the chances for success in life. This is not to suggest any form of demographic determinism. Yet being born a member of a large or a small cohort does alter one's odds for succeeding.

Baby Boom's Problems for Society*

Similar ups and downs will dog American society with the passing through of the vastly different Depression, baby boom, and baby bust generations. Manual Plotkin, former director of the Census Bureau, points out the problem:

> "The people born during the peak of the [baby] boom, the 1950s and early 1960s, will continue to be the largest population group throughout most of their lives. As this large group passes through each of these ages, the institutions that deal with population of particular ages will undergo the strain of rapid expansion and, a decade or two later, the often more painful task of precipitous retrenchment."[43]

It is perhaps safe to say that there are no societal problems, present or future, that do not have a demographic dimension. And for the U.S. today, the major demographic dimension is the existence of a very large cohort preceded and succeeded by small cohorts. Economist Robert Samuelson puts it this way: "You cannot understand economics or politics today without understanding the impact of the 'baby boom'."[44]

Many social scientists, planners and politicians have awakened to this simple reality only recently. The "discovery of demographics" showed up in President Carter's 1980 economic budget. "Demographic changes have substantial effects on the budget, some of which can

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*Some of the material in this section is derived from Robert H. Weller, and Leon F. Bouvier, *Population: Demography and Policy* (New York: St. Martin's Press, forthcoming 1981).

be anticipated. For example, we can estimate fairly accurately the number of people reaching retirement age a few years hence."[45]

At the heart of this new concern are two basic demographic concepts: the age structure of a population as a whole and the accompanying notion of cohorts, born in various decades. As the cohorts born in the 1930s, the 1950s, and the 1970s pass through life, they are disturbing the age structure of the U.S. population in the sense that the "normal" pyramidical pattern of a stable population is being disrupted by a cohort that is "too large" and two that are "too small." This is well illustrated in Figure 4. Disturbances in the age structure in turn can and do have tremendous impact on the society. Every institution will be affected. Each must plan in order to avoid the potential difficulties as these generations reach the ages with which it deals. The cohorts are born; they will go through all the stages of the life cycle. Fortunately, we know the numbers involved and, if we wish, can plan accordingly. As we will see below, that has not always been the case.

Education

Education as a social institution has perhaps been more affected by fertility variations than most other American institutions. The structure shifts resulting from the fertility fluctuations of the past 40 years have inevitably created substantial variations in school enrollment as well as in the number of available teachers. All three cohorts are involved in this problem.

In the late 1950s and 1960s, school enrollments soared as the baby boom cohort entered primary school and, later, secondary school. There they were taught, at least in part, by the relatively scarce members of the Depression generation. The elementary school age population (5-13) grew from 23 million in 1950 to 37 million in 1970. Shortages of teachers and classrooms plagued elementary schools as early as the mid-1950s, forcing them into double and even triple sessions. By the early 1960s, secondary schools were faced with similar problems. The high school population doubled in size between 1950 and 1975.

Soaring enrollments as the baby boom cohort reached college age helped fuel the student unrest of the late 1960s and early 1970s.

Colleges were next. Enrollments began skyrocketing in the mid-1960s, both from the sheer numbers of baby boomers and from the increased proportion of young people going to college. College students leaped from 3.2 million in 1960 to 9 million in 1975. Most certainly this dramatic demographic change helped fuel the student unrest of the late 1960s. The entire college environment changed in an incredibly short period, and that, coupled with the struggle over civil rights and pain of the Vietnam War, combined to give us the turbulent 1960s.

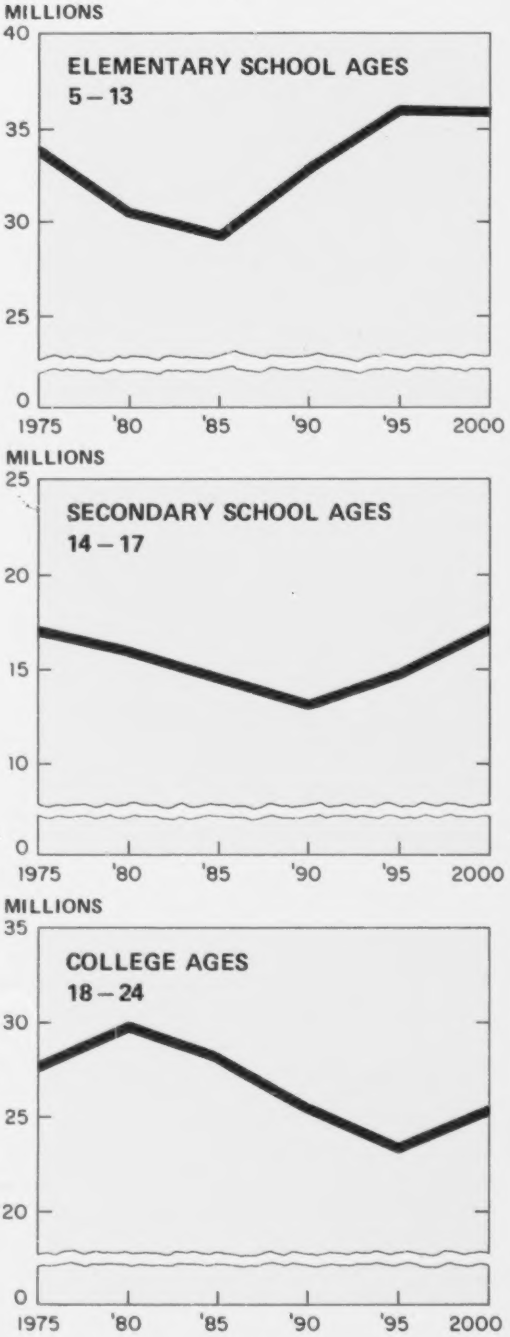
School planners were totally unprepared for the influx of youngsters entering school. In the early 1950s, few experts thought the baby boom would last into the late 1950s and early 1960s and administrators were not warned until it was too late. By the time new training schools had graduated enough teachers and massive building programs, voted unprotestingly by local taxpayers, had produced enough schools, the crest of the baby boom cohort was about to pass out of the school ages.[46]

Today, the situation has been turned around. There is a shortage of students and an excess of both teachers and school buildings. Again this can be explained demographically. Today's teachers are numerous not only because they come predominantly from the baby boom cohort but also because they were encouraged to become teachers by the shortages they themselves experienced while in school. On the other hand, the "shortage" of students in elementary schools--and, soon to be, in secondary schools—results from the low fertility of the 1970s. Now in 1980 there are fewer people aged 5-13 than there were in 1970 or even in 1965, and as Figure 5 shows, that number will fall even more by 1985 before growing slightly. The secondary school age population will follow a similar path a few years later:

> "The most notable fact is that each of the three school age groups is going to go through cycles in which the population declines for 10 to 15 years, and finally rises again. Thus the primary school ages can expect declines between now and 1985, marked gains between 1985 and 1995, further declines from 1995 to 2010, and finally gains after 2010. These same trends will have an impact on the secondary school population and college age populations about 5 and 10 years after they affect the primary ages."[47]

These temporary rises in enrollment that will occur later in the 1980s and on into the 1990s reflect the echo effect of the baby boom. Annual births have already turned up slightly (from 3.1 million in 1973—the bottom of the baby

Figure 5. Projected U.S. School Age Population: 1975-2000



Source: U.S. House of Representatives, Select Committee on Population, *Domestic Consequences of United States Population Change*, 95th Cong., 2nd sess., 1978, Figure 11, p. 45.

bust—to 3.5 million in 1979) and are expected to continue rising for some time, resulting in some increase in the number of children of school age five to ten years later. Ironically, the much-maligned teaching profession may offer good job possibilities in the not-too-distant future as a result of both the echo effect and the fact that not many college students are now entering that profession because of their perception of "not enough jobs."

The present combination of too many resources—faculties and facilities alike—and projections of enrollment increases in the relatively near future poses a dilemma for policymakers. It may be shortsighted to dispose of underutilized school buildings, knowing that enrollments will soon climb somewhat. Clearly, *flexibility* should be the guideline for policymaking, at least for the present. As to the long-run problem, some have suggested simply to have more babies. A larger school age population would, of course, create more jobs for teachers. However, it would also signal another population explosion—a dismaying alternative. A more productive alternative would be to improve the entire educational system by translating the decline in number of students into more resources per student.

Demographer Lincoln Day recently addressed this question:

> "Will this reduction in the number and proportions of school age children lead to an improvement in educational quality (however one cares to define this), or will it be seized upon, instead, as an opportunity to cut costs and allocate resources elsewhere?"[48]

To judge from reports of school closings across the country since the mid-1970s, school boards are overwhelmingly choosing the latter course of action.

Such decisions are unfortunate, not only for the children but also for American society itself. The cohort born in the 1970s—about 33 million—will probably prove to be the smallest cohort in the second half of the 20th century. It follows the massive baby boom cohort and will precede the echo cohort produced by the baby boom cohort as it reaches childbearing ages. Proportionately speaking, the number reaching the early stages of the professional-business part of the life cycle in about 2000 will be small. The nation cannot afford to waste any of this potential talent, rare as the source will be. It would be wise for society to ensure that this generation of the 1970s and early 1980s receives the best possible education to better train them for their adult responsibilities. As Alan Pifer suggests, in an article aptly entitled "Don't Forget the Children":

> "Every child alive today or born in the years just ahead, whether male, female, black, white, Hispanic or otherwise, will be a scarce resource and a precious asset as an adult in the early part of the next century. At that time, the nation's standard of living, its capacity to defend itself—perhaps its very viability as a nation—will be almost wholly dependent on the small contingent of men and women who are today's children."[49]

Household formation

Households, which now number approximately 80 million, grew by 15.5 million during the 1970s. This represents a 20 percent increase in just ten years. During the same period, the U.S. population grew by only 9 percent.

The baby boom generation are now young adults and are setting up their own households. This partly explains the vast increase in households. But there are other demographic factors involved. Families are getting smaller. Fertility has been falling; fewer young married couples live with their parents; and there are more one-parent families. Also, there are more single adults. Young people are postponing marriage, yet they leave their parental homes at an earlier age to set up housekeeping than past generations did. Divorce is becoming more common and each divorce usually adds yet another household. Annual divorces went over a million in 1975, and by 1979 were up to 1.2 million. Finally, people are living longer and more of the elderly are maintaining their own homes.[50] Thus, demographic factors, especially the baby boom, are having a significant impact on one of society's most important institutions—the home.

Many changes in the *nature* of household composition have occurred in recent years and will continue to occur in the future, attributable in large part to the factors listed above. Non-family households have increased at a more rapid rate than have family households—66 percent compared to 12 percent over the 1970 decade (see Figure 6). Most of this increase among non-family households is accounted for by young people who have never been married or who are separated or divorced.[51]

A very different profile of households emerges as we enter the 1980s. In 1970, 81 percent of all U.S. households were family types—70 percent maintained by married couples and 11 percent by single parents. In 1979, only 61 percent of all households included married couples and 13 percent were headed by single parents. Over a quarter of all households were classified as non-familial (Figure 6).

Households will continue to increase rapidly. The Census Bureau foresees over 96 million households by 1990—another one-decade gain of about one-fifth. By the turn of the century that number will undoubtedly surpass 110 million. In 1990, perhaps as few as 57 percent of all households will be husband-wife types. Another 14 percent will be headed by a single parent and the remaining 29 percent will be non-family households. These projections reflect the changes that have been taking place in recent years in age at marriage, divorce, family size and, of course, changes in age composition resulting from the baby boom and baby bust generations. Much of the future size and characteristics of households is dependent not only on the numbers but also on the behavior of the large baby boom cohort:

> "The behavior of this generation as it passes through its 20s and 30s [about 1975 to 1994], the traditional years for forming households, is not easy to predict. The decisions members of this group make about marriage, divorce and fertility should have a profound impact on what future households will be like."[52]

This mammoth increase in household formation is of course directly related to the consumer demand for housing. As economist William Serow points out:

> "Today, the rate of household formation—which most directly influences the growth rate of demand for housing—is much greater than the rate of population growth because of the large number of young adults in the population and the increasing incidence of divorce. While the former is essentially transitory, another consequence of the baby boom, the latter may well be permanent. Slower population growth is also likely to affect the composition of housing demand (smaller units with more convenience and luxury features), as well as to provide additional demand for second homes."[53]

Regardless of the *types* of housing desired by the new consumers of the 1980s one thing is certain: the large number of such new potential home buyers is a prime factor in the spiraling cost of housing which shares with soaring energy costs the leading role in fueling current inflation. The *Wall Street Journal* comments: "Now the big part of the [baby boom] bulge is between 20 and 30 years of age, the usual period of household formation, and it is beginning to dominate the housing market."[54] During the 1970s, 32 million Americans reached age 30—a milestone age for home purchasing. About 42 million will turn 30 during the 1980s. There will probably be little drop in housing demand until the 1990s when the baby bust cohort enters the market.

Quoting economist Dwight Jaffe, the *Wall Street Journal* continues:

> "For the [building] industry, the demographic factors are the most positive they've been in a long time. He (Jaffe) expects an average of slightly more than two million housing starts a year over the next 10 years, compared with an average of about 1.7 million over the past 10. 'The industry is ratcheted up a whole notch. The 1980s are going to be glorious.'"

These optimistic views are not subdued by the prospect of ever higher interest rates on borrowing and tighter credit regulations. It will not be enough to flatten the rise, contends Kenneth Rosen, Princeton economist, "even high interest rates aren't likely to kill this boom because it's demographically based."

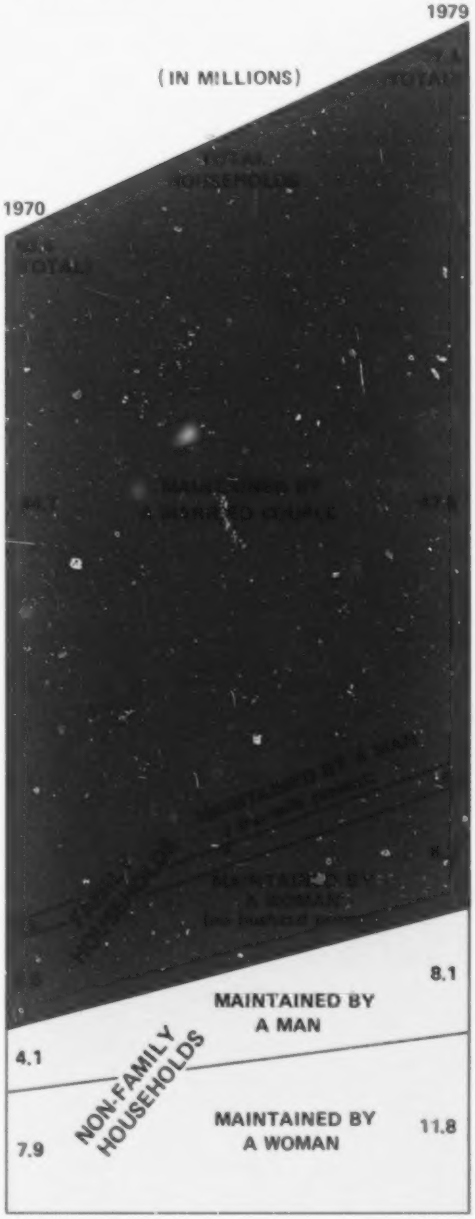
The giant generation as it enters the stage of life when household formation is most likely is thus having a tremendous impact on that particular aspect of society. The impact stems not only from its sheer size but also from its own demographic behavior—low fertility, later age at marriage, increased female labor force participation. Together these factors are contributing to major changes in the nation's family and household makeup as well as booming sales for the housing industry and its subsidiaries such as furniture and appliance manufacturers.

The labor force and employment

During the 1976 presidential campaign, candidate Jimmy Carter argued that the number of unemployed people had increased during the Nixon-Ford years. The then incumbent president, Gerald Ford, countered that more people were employed during those years than ever before in history. Many voters saw this exchange as just another example of campaign rhetoric, but both candidates were telling the truth.

Population increases result in more

Figure 6. Number of U.S. Households by Type: 1970 and 1979



Sources Note: Adapted with permission from Arthur J. Norton and Paul C. Glick, "What's Happening to Households?" *American Demographics*, Vol. 1, No. 3 (March 1979) p. 20, updated to 1979 from U.S. Bureau of the Census, "Households and Families by Type: March 1979 (Advance Report)," *Current Population Reports*, Series P-20, No. 345, October 1979.

people being available for employment. Most of them are actually working. However, by 1976 the baby boom had greatly expanded the proportion of teenagers and young adults in the population and it is in these groups that unemployment rates tend to be greatest. Thus the number of unemployed people increased at the same time that the number of employed persons also increased.

Since 1976, however, there has been a shift in this trend. In the election month of that year, November 1976, the U.S. labor force stood at 95.8 million people—88.3 million of them employed and 7.5 million unemployed. The overall unemployment rate was thus 7.8 percent. In March 1980, the total work force was up to a near record 104.1 million. Employed persons had increased by nearly 10 million to 97.7 million, while both the number of unemployed (6.4 million) and the unemployment rate (6.2 percent) were well below the 1976 level.[55]

In response to the baby boom's arrival at working age, the U.S. labor force added an average of over 2 million people a year from 1968 to 1978. Most of the new entrants were young people. By 1978, 58 percent of all teenagers were either working or looking for work—nearly 5 million more than in 1960. Inexperienced teenagers take longer to find work and switch jobs more often and thus force up the general unemployment rate. A recent Bureau of Labor Statistics report noted that the U.S. economy had created 12 million new jobs from 1974 to 1977, but unemployment was reduced by only 2 million because so many of the new jobs were taken by new entrants.[56]

The pressure of the baby boomers on the job market during the 1970s was compounded by an enormous influx of women. Labor force participation rates for women soared in part because of the baby bust fertility decline. The increase is startling: in 1960, 35 percent of all women aged 16 and over were working or actively seeking employment. Today in 1980, over half of all women are in that category. Nineteen million women joined the work force between 1960 and 1974, accounting for 60 percent of its growth.[57]

An outstanding feature of women's entry into the labor force has been the increased participation of married women, particularly those with preschool age children. In the past, these women were least likely to be employed, yet since 1965 the most rapid increases in rates of labor force participation have been among women with children under 6 years of age. Evidently factors which once kept women off the job market such as marriage and/or young children are now being outweighed by inflationary pressures on family budgets and women's desires for their own occupation and income.

With over half of women already working and the bulk of the baby boom cohort due to move beyond the job-entry stage, labor force growth will probably decline during the 1980s. Economist Alan Greenspan puts the likely rate of increase during the next decade at 1.7 million persons per year or 1.6 percent, somewhat slower than in the 1970s. Even that growth rate itself will fall through the decade from 2.3 in 1977 to 1.2 in 1990. He comments:

> "In any case, the tapering off of new entrants leads to the assurance of a more mature work force in the 1980s. By 1990, seasoned workers in the prime of their working lives, that is between the ages of 25 and 54, will constitute 70 percent of the labor force. Women will be contributing a lot, in different ways, to the accretion of experience. Right now, women have fewer years on their current job than men, especially in the older age groups. But that gap is already starting to narrow. An increase in early retirement is removing men with longer tenures, while women's working careers are getting longer than they used to be."[58]

The changing age structure of the near future should bring some good news, economically speaking. The number of elderly will increase (though their proportion of the population will grow only slightly for some time) while the number of infants and children will decline (assuming continued low fertility). Thus there will be more workers and fewer people dependent on them. A decrease in the number of dependents should cause per capita income to rise even in the absence of any increase in real earnings. But there is reason to anticipate that declining population growth will increase real wages in the next few years. Economist William Serow notes:

> "First, as the baby boom youth pass into middle age, their unemployment rate will decrease and their earning level will increase. Second, because smaller cohorts will replace them at the entry level, that means the need to devote a large share of capital to equip them will lessen. If the amount of capital available per worker increases, and with it the productivity per worker, real wages could rise without contributing to inflation."[59]

These labor force forecasts generally assume continued low fertility and continued participation of married women. Changes in these, as well as in the size and age composition of the immigration stream, could substantially affect both the size of the labor force and its age composition, especially after 1990. In any event, it is clear that the U.S. economy will have to generate still more millions of jobs to cope with newly available job seekers who will continue to flood into the labor market over the next two decades. Given high rates of inflation and low rates of investment, meeting this need will prove difficult.

Political institutions

In November 1980 when the presidential election takes place, people aged 18-29 will represent the cohort born between 1951 and 1962—the heart of the baby boom. These under-30 potential voters will comprise 30 percent of the potential voting population—the highest proportion ever for this age group and the highest it may ever be. Nevertheless, neither political party appears to be emphasizing a youth-oriented platform. Indeed, the emphasis seems to be aimed at attracting older voters.

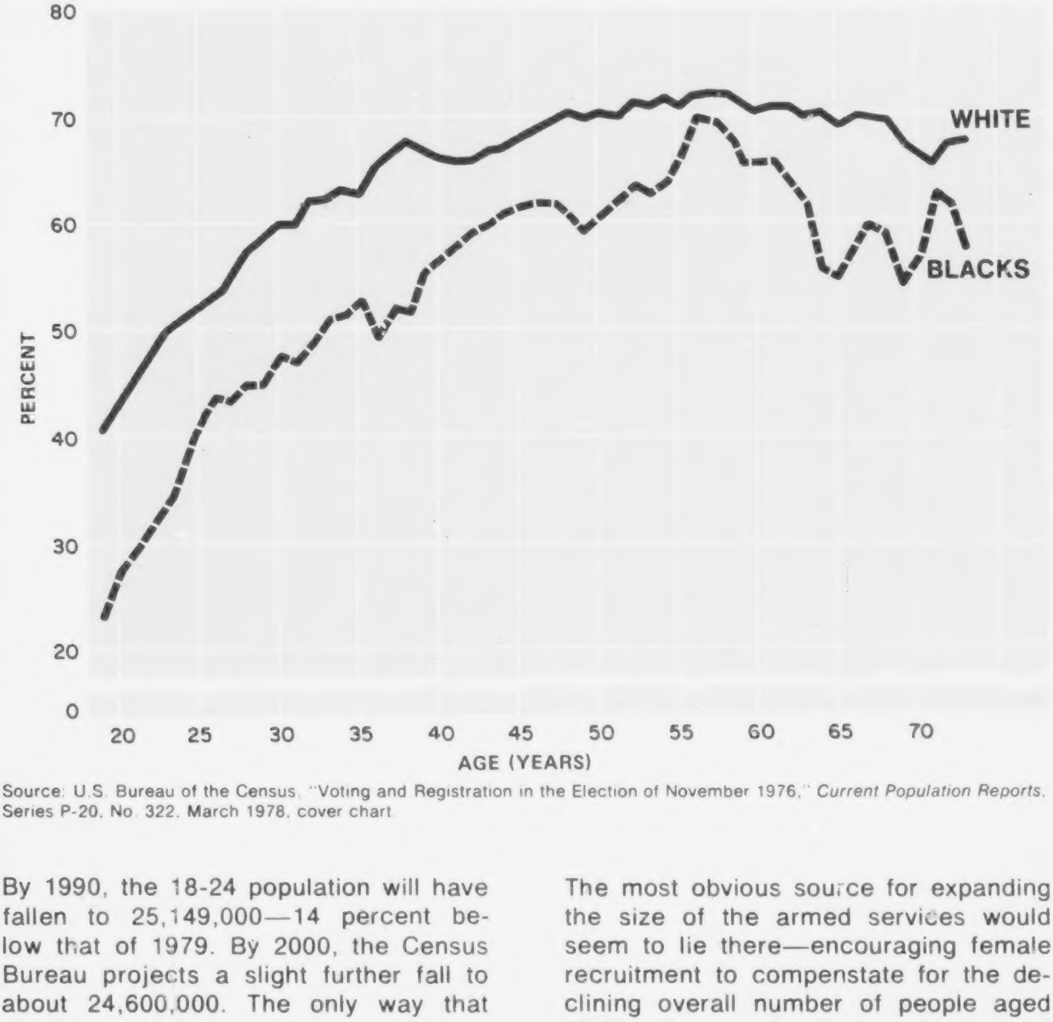
The reason is relatively simple. Young adults and teenagers are not as likely to vote as are their older counterparts. Figure 7 (page 28) shows the proportion of people of voting age (18 and over) who voted in the most recent presidential election of November 1976. Only 38 percent of the people aged 18-19 voted; about half of those 25-29 voted; but 70 percent of those 55-64 did so. The situation was even more dismal in the 1978 Congressional election. Only 18 percent of the 18-19 age group voted and about a third of those 25-29. But 61 percent of the 55-64 group voted. There is a direct correlation between age and the propensity to vote—at least up to age 65.

If such a correlation is maintained, it will be another 20 years before the baby boom generation has any real impact on the election process in the United States. However, should this potentially powerful voting block be motivated because of some specific issue perceived as being directly related to its interests, it could possibly become the prime force in the election—and of course in the defeat—of any particular presidential candidate.

The impact of birth cohorts on political institutions cannot be discussed without some mention of the military—that part of the political institution apparently responsible for the maintenance of a peaceful co-existence with other nations.

The most likely group to be called up for military service is that between the ages of 18 and 24. Census Bureau estimates for July 1, 1979, indicate a population aged 18-24 of 29,285,000. These people were born between 1954 and 1961—peak baby boom years. The number of people aged 18-24 will drop substantially over the next two decades.

Figure 7. Percentage of Persons of Voting Age Reporting Voting in November 1976 Election



Source: U.S. Bureau of the Census, "Voting and Registration in the Election of November 1976," *Current Population Reports*, Series P-20, No. 322, March 1978, cover chart.

By 1990, the 18-24 population will have fallen to 25,149,000—14 percent below that of 1979. By 2000, the Census Bureau projects a slight further fall to about 24,600,000. The only way that number could be raised would be through increased immigration of persons young enough to be in the 18-24 age bracket in 1990 or 2000. One would have to also assume that many of these immigrants would be willing to serve in the U.S. armed forces.

Of course, not everyone aged 18-24 serves in the military even in wartime. While the number of women recruits has gone up in recent years, women still comprised only a small 7 percent of the armed forces at the end of 1979 (154,800 of a total of 2.3 million).[60] The most obvious source for expanding the size of the armed services would seem to lie there—encouraging female recruitment to compenstate for the declining overall number of people aged 18-24, the result of the changes in U.S. fertility between the 1960s and the 1970s. This alternative appears unlikely in the near future, however, considering the negative public reaction in early 1980 which forced President Carter to drop the proposal that young women as well as men should register for a potential draft.

The probability of voting among young adults may be related to the probability of being drafted into the military service. Currently the pool of potential draftees is large. But it will soon begin to shrink. The pool of potential young voters is now also large. Is a military draft the kind of issue that could unite this potential voting block?

The elderly and Social Security

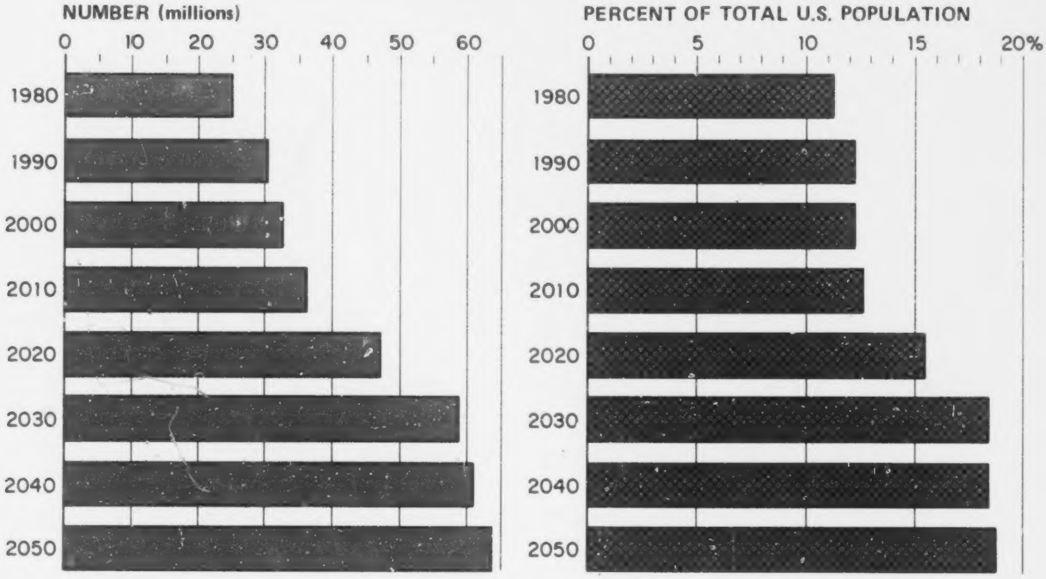
Much has been written about the coming "senior boom." Unfortunately, much of the speculation is incorrect. Indeed, misinformation has been so rampant that the Census Bureau found it necessary to comment on this issue in a recent report on the elderly:

> "Obviously statements sometimes made in the press and elsewhere that over one-third of the population of the United States will be over 65 years in another quarter to half a century are unfounded. This would be 'possible' only if fertility continued at replacement or sub-replacement level and death rates were reduced to zero or near zero in the next few years."[61]

Currently, there are about 25 million people aged 65 and over in the U.S. That number will ease up to about 31 million at the turn of the century. Only after 2010 will the number escalate and reach perhaps 59 million by 2030 (see Figure 8). This growth pattern of the elderly population reflects the size of the Depression cohort as well as that of its successor of the baby boom. Indeed, the decennial percent increase in the population 65 and over will be very small in the 1990s, a consequence of the low fertility of the 1930s. It will soar between 2010 and 2020 and between 2020 and 2030 as the baby boom generation enters the last stage of its life cycle.

Up to 65 years in the future, we can be quite certain of the number of elderly persons in the total U.S. population. More difficult is to project what proportion they will comprise of that total as this depends on future fertility behavior. Higher fertility means a lower proportion of elderly; lower fertility means a higher

Figure 8. Projected Number and Proportion of Persons Aged 65 and Over in the U.S. Population: 1980-2050



Source: Special unpublished tabulations prepared by Leon F. Bouvier for the Select Commission on Immigration and Refugee Policy, 1980. For fertility, mortality, and migration assumptions underlying these projections, see Figure 4.

proportion of 65-year-olds and older. According to the assumptions of this *Bulletin*, the elderly will make up about 19 percent of the total U.S. population of 2030—almost double the 11 percent of 1980 (Figure 8). In other words, 50 years from now nearly one of every five Americans will be aged 65 or more compared to just over one in ten today.

As the baby boom cohort moves through its retirement years it will create one last major disturbance for society. The generation which caused an upheaval already in the late 1950s upon entering the school system will not simply disappear quietly. Its most significant disturbance for society will probably come in its final stage of life. Furthermore, because of both its sheer size and its gains from increased life expectancy, growth within the elderly baby boom cohort will be overwhelmingly among those aged 75 and over. Thus the elderly group itself will grow older and in so doing will prolong the cohort's existence.

Increased proportions of the elderly will require changes in consumption patterns as well as a vast reordering of public priorities. Goods and services which are used more with advancing age will be in increased demand: nursing homes, hospitals, pharmaceutical products, group housing arrangements, homes for the aged, etc. Judging solely by demographic considerations, not only will total spending on the elderly rise but also the *average* spent per person aged 65 and over will go up because there will be more of them in the very oldest, most dependent ages.

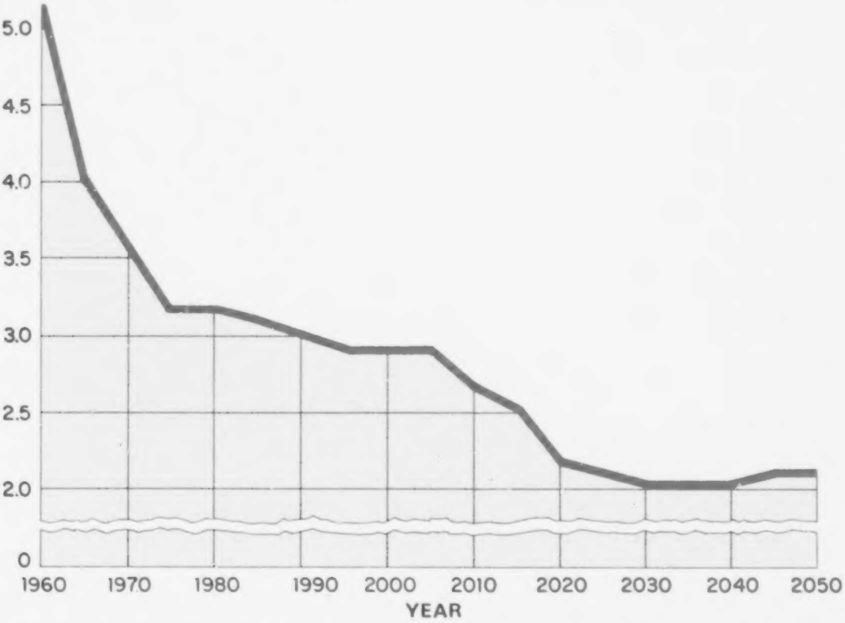
The changes in public priorities are less visible but perhaps more dramatic. Increasingly, we speak of the "graying" of the U.S. budget because of the increased proportion of funds earmarked to serve the elderly. In 1969, the elderly received 17 percent of the federal budget. In fiscal year 1981, one quarter of the total federal budget will go for support of older people and their dependendents—an amount larger than requested for any other single category of federal expenditure including defense. This share might reach 40 percent in 2025 when the baby boom elderly population is at its peak, according to former HEW Secretary Joseph Califano.[62]

Looming large among the potential problems associated with future growth of the aged population is the Social Security system. Currently the system is experiencing financial problems. One reason, though not the only one, is the increasing number of 65 year-olds and older. These problems will intensify after 2010 when that age group is taken over by the baby boom cohort. The middle-aged persons who will then be working and paying into the Social Security pool will be those of the smaller baby bust cohort. Thus relatively fewer economically active people will be paying for the "welfare" of an increased number of elderly. An inter-generational quarrel is not impossible, given the situation.

Looking only at the elderly population overstates the problems and greatly oversimplifies the issue of dependency. As Figure 9 shows, the massive growth in the elderly population in the early part of the next century does translate into a falling number of persons paying Social Security payroll taxes in relation to each elderly beneficiary. But if fertility remains low, the proportion of dependent children in the total population will go down which will compensate for the increase in the elderly population. Rather than concentrate solely on the future proportions aged 65 and older, economic planners should be looking at the total "dependency ratio." Doing so yields a more complete picture.

In 1980 there were 64.7 people of dependent age (under 18 or 65 and over) for every 100 persons in the working ages (18-64). If fertility stays at 1.8 births per woman and net immigration at 750,000 per year, by 2000 the dependency ratio will have *dropped* to 58.6. Even in 2020 when the baby boom

Figure 9. Projected Number of Persons Paying Social Security Payroll Taxes per Beneficiary Aged 65 and Over: U.S., 1960-2050



Source: U.S. House of Representatives, Select Committee on Population, *Domestic Consequences of United States Population Change*, 95th Cong., 2nd sess., 1978, Figure 13, p. 73.

cohort begins to retire, the total dependency ratio would only be 61.2—still below the 1980 level. Indeed, if fertility increases to 2.0, in line with our earlier assumption, the dependency ratio of 2020 would also be below that of 1980—64.3 versus 64.7.

Although the growing elderly population will pose difficulties for society, a major problem may well be that of developing the will and commitment necessary to switch the emphasis from expenditures for the young to expenditures for the aged. Making such a shift is far from simple. Political difficulties can be foreseen when it is suggested that the two age groups are interchangeable. Currently public expenditures to support an elderly person are three times what they are per youth. Also much public spending on young people is for education which is financed largely by state and local taxes, whereas most public spending for the elderly comes from federal funds. An increasing proportion of older persons could thus raise the issue of federal versus state and local responsibilities and spending.[63]

Obviously major alterations in our overall economic, social, and political systems will have to occur if we are to provide adequate care and shelter for the senior citizens of 40 years hence. Fortunately there is time to plan for these changes. Because the baby boom cohort is now entering the labor force and will continue to swell the ranks of the employed for the next 20 years, there will be no marked increase in the ratio of elderly persons to working-age population until after 2010. Only then when the baby boom generation becomes the senior boom will its place in the work force be taken by the baby bust cohort. The ratio of people 65 and over to the active population will rise rapidly to a peak in 2030. The changes will be drastic and it is not too early to begin adequate preparations for their coming.

The Future: Dismal or Happy?

It might seem reasonable to conclude that all will not go well with U.S. society until the giant baby boom generation passes out of existence around the middle of the 21st century. There can be no denying the many disturbances that emanate from this interruption of the long historical decline in fertility—a trend resumed with the somewhat misnamed baby bust of the 1970s. Clearly the sudden "dumping" of an extraordinarily large number of people of a specific age on the society necessarily results in certain upheavals in that society's institutions.

All the news is not bleak, however. The baby boom generation is on the verge of entering the most productive phase of life. It has all but completed the earliest troublesome phases and U.S. society has survived! That the baby bust generation follows is also reason to be optimistic about the future.

As the number of people diminish in those troublesome early life stages—school age, early adulthood, family formation—the problems attendant to those ages will also decrease.

Further, as the baby boom cohort sheds its "dependent" label and becomes "economically active," it should cease being a burden on society. Whereas having "too many children of school age" was a problem for society, having "too many active adults" will be a boon for the society. The dependency ratio will fall as more people are added to the active population (18-64) while the number of young dependents will decline because of the baby bust and the number of elderly dependents will grow only slightly—the increase held back because of the good times cohort (born in the 1930s):

> "This demographic change should not fuel inflation and it should have little effect at all on total consumer demand, although it will change the composition of that demand. . . . Income per person will rise in the next few decades as the relative size of the working-age population rises simply because the number of young dependents will be comparatively small. Unemployment rates should diminish as the labor force grows older, leaving entry-level positions to the smaller generation following."[64]

Finally, because of its sheer size, the baby boom cohort has forced society to restructure a number of its institutions. Educational facilities and faculties—from kindergarten to graduate school—are in place and generally sufficient to handle future enrollments, thanks to pressure from the baby boom generation. Housing stocks have soared in recent years and, barring economic difficulties, will continue to soar during the 1980s because of pressure from the baby boom generation. The near future will see the creation of more slots in the economy, filled first by members of the baby boom generation and then made available for the next generation. But there is a complication here:

> "The maturing of the [baby boom] generation is going to take place at the same time as the energy crunch raises costs and slows down the economy. If this combination is not thought about fairly carefully before fully into it, it could prove disastrous. However we respond, the population bulge increases the likelihood that we will switch from being a consumer society to being more a conserver society."[65]

The baby boom generation's final impact may also be positive, although it could at first be extremely troublesome. The huge numbers of elderly after 2020 will pose a final enormous baby boom problem for U.S. society. Yet the long-run contribution may well be positive. With the political clout they could wield, the baby boom elderly could assure social changes that would protect and benefit the oldest citizens of following generations.

Whatever does occur to our society, we can be certain that the behavior of the baby boom generation will be a major contributor. Future planning must constantly take into account the fact that back in the late 1940s young Americans decided to marry early, have their children soon after marriage, and produced somewhat larger families than their parents did and that pattern was not abandoned until the mid-1960s. The giant baby boom generation resulted and will be with us for another 70 years. □

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Sweden Faces Zero Population Growth

Abstract—Despite a wide range of family supports, Sweden's birth rate was down virtually to its death rate in 1979 and its population is projected to decline from 1986 on. This *Bulletin* examines the causes of the fertility decline and the concerns and ambivalence of Swedes about zero population growth, reminiscent of the 1930s when birth rates also fell to record lows, and which they now share with others of their European neighbors. The fertility decline is related to a drop in marriage rates and sharp increase in non-marital cohabitation, increasing education and escalating employment rates among women, the cost of children in the face of high tax burdens and living costs, and increased availability of effective contraception and legal abortion. If fertility remains below replacement at 1.8 births per woman and immigration balances emigration as now projected, the proportion of persons 65 and older will rise from 16 percent in 1977 to 20 percent of the population in 2025, higher than has been conjectured for a ZPG society. Financing retirement and medical benefits for the elderly already demands nearly half of the large total spent on social welfare and is escalating. Since World War II Sweden has welcomed refugees and until the 1970s encouraged immigration to fill labor needs. Integrating the newcomers into the historically homogeneous society has caused problems despite conscientious policy efforts. Reducing immigration could mitigate these problems but could also mean an earlier and faster population decline than now projected. By 1979, the low population growth rate of 0.2 percent was entirely accounted for by net immigration plus natural increase among immigrants. Among Swedish citizens, who still make up all but some 425,000 of the 8.3 million population, there were fewer annual births than deaths from 1976 to 1978.

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By Murray Gendell

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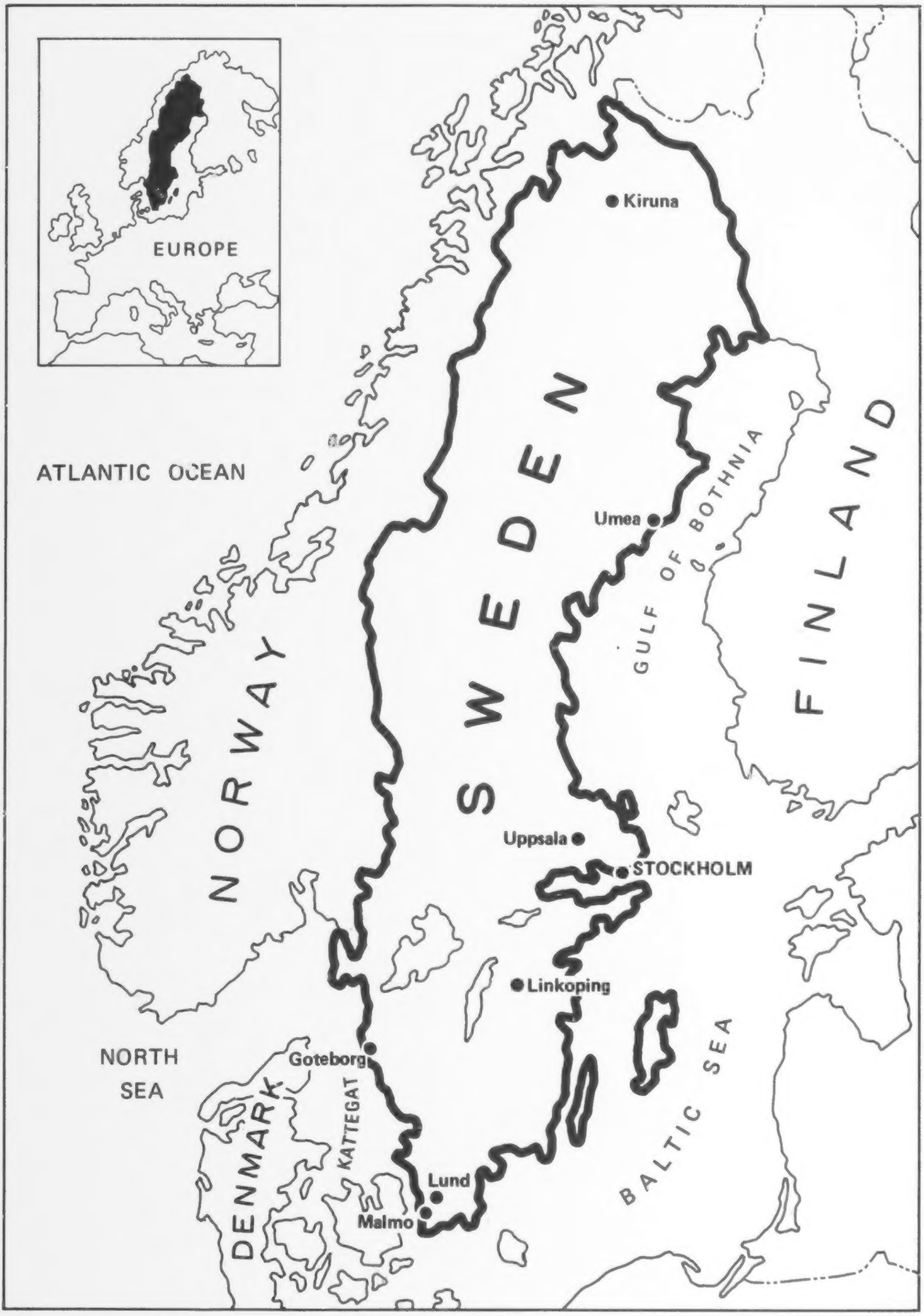
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Sweden Faces Zero Population Growth

By **Murray Gendell**
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Dr. Gendell acknowledges the assistance of the staff of the Swedish National Central Bureau of Statistics in providing material for this Bulletin, *particularly Mr. Arne Arvidsson and Dr. Anne-Marie Bolander. Mr. Dag Swenson of the National Board of Health and Welfare and the staff of the Swedish Embassy in Washington, D.C., were also helpful. Dr. Gendell is also grateful to his colleague Conrad Taeuber for useful comments on the manuscript and to the editor [illegible] the* Population Bulletin, *Jean van der [illegible], whose patience was as great as her energy and enthusiasm.*

Located in Northern Europe on the eastern half of the Scandinavian peninsula, Sweden shares boundaries with Finland to the east and Norway to the west, with Denmark close by across the Kattegat Sea to the southwest. Its land area is about the same as California's and population density a low 52 persons per square mile, compared to 61 in the United States. The 1980 population is estimated at 8.3 million people (a little less than that of North and South Carolina). Virtually the entire population lives in the southern half of the 1,000-mile-long country and 83 percent in "densely populated areas" of at least 200 persons.

Historically, Sweden's population has been extremely homogenous. The only ethnic and linguistic minorities residing in the country for any length of time have been the Lapps, now numbering about 10,000, a Finnish-speaking group of some 40,000 in 1970, and a few thousand gypsies. Officially, all but a few percent of Swedish citizens are Protestants belonging to the Lutheran state church, but Sweden is a very secular society; in 1968, for example, only 2 percent of the population attended church at least once a week. The country is a constitutional monarchy with a long tradition of parliamentary government. A one-house parliament replaced the two-chamber system in 1971. The Social Democratic Party held the majority in the government for 44 years until 1976, the longest governmental dominance of any European political party in this century. Since then the parliamentary majority has been held by varying coalitions of right-of-center "bourgeois" parties.

For the outsider, Sweden provokes a mix of admiration, envy, and curiosity. Its infant mortality rate is lowest in the world and life expectancy surpassed only by that of Iceland. The country has managed to remain aloof from all wars since 1814 and is abundantly endowed with such valuable natural resources as iron ore, timber, and hydroelectric power. Its people enjoy the world's seventh highest per capita income ($10,210 in 1978, ahead of the U.S. at $9,700), no slums and little poverty, an unemployment rate of 2 percent, and one of the world's most comprehensive systems of social welfare. A wide range of child and family allowances, health provisions, free education through university, and retirement benefits protect its citizens and foreign residents alike from cradle to grave. And Sweden has been a forerunner in promoting equality for women.

It has also been a forerunner in changing lifestyles. By 1978, Sweden led all industrialized countries in the proportion of cohabiting couples who were unmarried (15 percent) and the percentage of total births borne out of wedlock (36 percent). But socially, as well as legally, Sweden has erased all distinctions between children born in or out of wedlock.

Sweden is also among the dozen or so European countries where annual births have now dropped virtually to or below the numbers of annual deaths. Its unease with this state of affairs, like that of several of its neighbors, may presage concerns which the prospect of zero population growth could arouse among other developed countries, such as the U.S., where fertility is now below the level needed to replace the population in the long run. (Twenty-four countries population currently have a replacement-level total fertility rate of 2.1 births per woman or lower.* For some, such as the U.S. where the total fertility rate in 1979 was about 1.85,[1] such a low rate is a recent phenomenon. Past higher levels of fertility, like the baby boom, mean that there are still considerably more people in or about to enter the childbearing ages than there are at older ages. It will take several decades of sustained fertility at two births or fewer per woman before the disproportion in the relative size of different age cohorts disappears and annual births—persons "entering" the population—come down to the level of annual deaths—persons "leaving" the population—and the population stops growing from "natural increase." In most Northern and Western European countries, however, fertility has been low enough for long enough that zero population growth—leaving immigration out of account—is already here, or all but. Fertility has recently risen *above* replacement level in Eastern Europe, except for East Germany and Hungary, in response to deliberate pronatalist government policies. Fertility has also taken a turn upward in the U.S.S.R. and now stands at about 2.4 births per woman because of continued high fertility among Central Asian non-Russian peoples who comprise an increasingly large portion of the total U.S.S.R. population.)

Birth rates also fell to record lows in Sweden in the early 1930s during the Depression as they did in most industrialized countries. Sweden's response then was characteristically groundbreaking. The 1934 publication of *Crisis in the Population Issue* by Gunnar and Alva Myrdal touched off a public debate concerning the threat of "self-perpetuating liquidation of the people." Two successive government commissions on population were appointed to make recommendations aimed at promoting a level of fertility which "would keep the population in the long run at least constant, with mortality as low as possible." The programs that resulted, however, were set within a broader social and economic context that still stands as a model for governments concerned about the total quality of life of their peoples.

Measures adopted by Sweden's parliament in the late 1930s and 1940s to strengthen the family (and, coincidentally, fertility) included child, marriage, and housing allowances, low-cost (and now free) maternity and child health services, maternity benefits, day-care centers, free school lunches, and guaranteed job security for women workers who marry or become pregnant. At the same time, steps were taken to eliminate unwanted childbearing: most restrictions on contraception were repealed, the abortion law was substantially liberalized, and sex education was introduced in schools.

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*Canada and the United States, in North America; in Europe: Austria, Belgium, Denmark, Finland, France, East Germany, West Germany, Hungary, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Sweden, Switzerland, United Kingdom, Yugoslavia; and Australia and Japan. Plus two less developed countries: Cyprus and Singapore.[2]

Whether or not encouraged by these policies, birth rates rose in Sweden during the 1940s and again in the 1960s as in most European countries and population concerns subsided. By the mid-1970s, however, concerns flared again as fertility fell well below replacement level. At the same time, the death rate rose slightly. In 1979, the crude birth rate was 11.6 and the death rate 11.0 per 1,000 population (compared to 15.8 and 8.7, respectively, in the U.S.). Sweden's current "medium" official projection foresees a steadily declining population as from about 1986.

The new public and parliamentary debate focuses on the consequences of sustained low fertility for the proportion of elderly people who must be supported and the role played by immigration in population growth. If fertility remains below replacement as now projected, the proportion of persons 65 and older in the population is due to rise from today's 16 percent to 20 percent in 2025. Costs of generous retirement and medical benefits for the elderly already make up close to half of Sweden's very large social welfare bill and are escalating much faster than those for other items in that bill. Immigration plus natural increase among immigrants accounted for nearly half of Sweden's population growth from 1944 to the mid-1970s and by 1979 accounted for all of the low annual growth of 0.2 percent. Among Swedish citizens, there have been fewer births than deaths every year since 1975. Following World War II and until the 1970s, Sweden needed foreign workers to maintain economic expansion and, in line with its well-known humanitarian instincts, welcomed substantial numbers of refugees. However, integrating the newcomers with their different languages and cultures into the formerly highly homogeneous Swedish society has presented problems which have not yet been successfully resolved, despite a far-ranging, conscientious policy effort. Reducing immigration would mitigate these problems and, indeed, controls on non-Nordic immigrants have been tightened. But if immigration is now discouraged and fertility remains low among native Swedes, the country's population may well decline sooner and faster than projected.

In a world beset by rapid population growth, many Swedes are uncomfortable at the thought of stimulating population growth at home. Sweden was a pioneer in the international family planning movement and the first developed nation to provide family planning assistance to the less developed world (beginning with a pilot project in Ceylon in 1958). Nevertheless, low fertility has increasingly captured the attention of the press and parliament in recent years. No new legislation designed to influence population growth trends has so far been enacted but, if the birth rate continues to fall, such action seems likely.

To set these concerns in context, this *Bulletin* opens with a sketch of Sweden's past population growth and as projected for the future. Recent trends in fertility and marriage are then described along with the changes in women's status and availability of modern contraception and legal abortion that have probably influenced them. Sections follow on mortality trends, the aging of the population and the problems this causes, and on immigration trends and policy. The conclusion takes a closer look at the current population debate and the extent to which Sweden's situation resembles what might be expected of a "ZPG" society.

Table 1. Components of Population Growth in Sweden: 1751-1979

	Number per 1,000 population							Mean population for period or at end of specified year (000s)
Year	Births	Deaths	Natural increase	Immigration	Emigration	Net migration	Population increase[a]	
1751-1800	33.6	27.4	6.2				5.5	2,066
1801-1850	32.2	23.9	8.3				8.1	2,790
1851-1900	30.0	18.5	11.5		4.2		7.6	4,343
1901-1950	19.4	12.5	6.9	1.6	2.0		6.4	6,001
1955	14.78	9.45	5.33	4.14	1.75	2.39	7.53	7,290
1960	13.66	10.04	3.62	3.49	2.02	1.47	4.79	7,498
1965	15.88	10.11	5.77	6.41	2.07	4.35	10.00	7,773
1970	13.70	9.95	3.75	9.61	3.56	6.05	9.83	8,081
1971	14.14	10.21	3.93	5.26	4.88	0.38	4.30	8,115
1972	13.82	10.35	3.47	3.68	5.12	−1.44	1.93	8,129
1973	13.48	10.53	2.95	3.62	4.96	−1.34	1.48	8,144
1974	13.46	10.58	2.89	4.59	3.47	1.11	3.91	8,177
1975	12.65	10.77	1.88	5.39	3.33	2.06	3.87	8,208
1976	11.96	11.03	0.93	5.53	3.10	2.43	3.34	8,236
1977	11.64	10.69	0.95	5.33	2.55	2.78	3.70	8,267
1978	11.27	10.84	0.43	4.37	2.68	1.69	2.08	8,284
1979	11.56	10.97	0.59	4.46	2.77	1.69	2.29	8,304

Sources: 1750-1950: National Central Bureau of Statistics (NCBS), *Historical Statistics of Sweden*, Part I: *Population 1750-1950* (Stockholm: 1955) p. 37; 1955-1978: NCBS, *Population Changes 1978*, Part 3 (Stockholm: 1980) Tables 1.1 and 2.1; 1979: Press release from the NCBS in *The Swedish American Newspaper* (Chicago), January 23, 1980, p. 1.

[a] Natural increase plus net migration should equal population increase. Minor discrepancies are due to transfers of persons with "residence unknown" to and from the population register.

Population Growth in Perspective

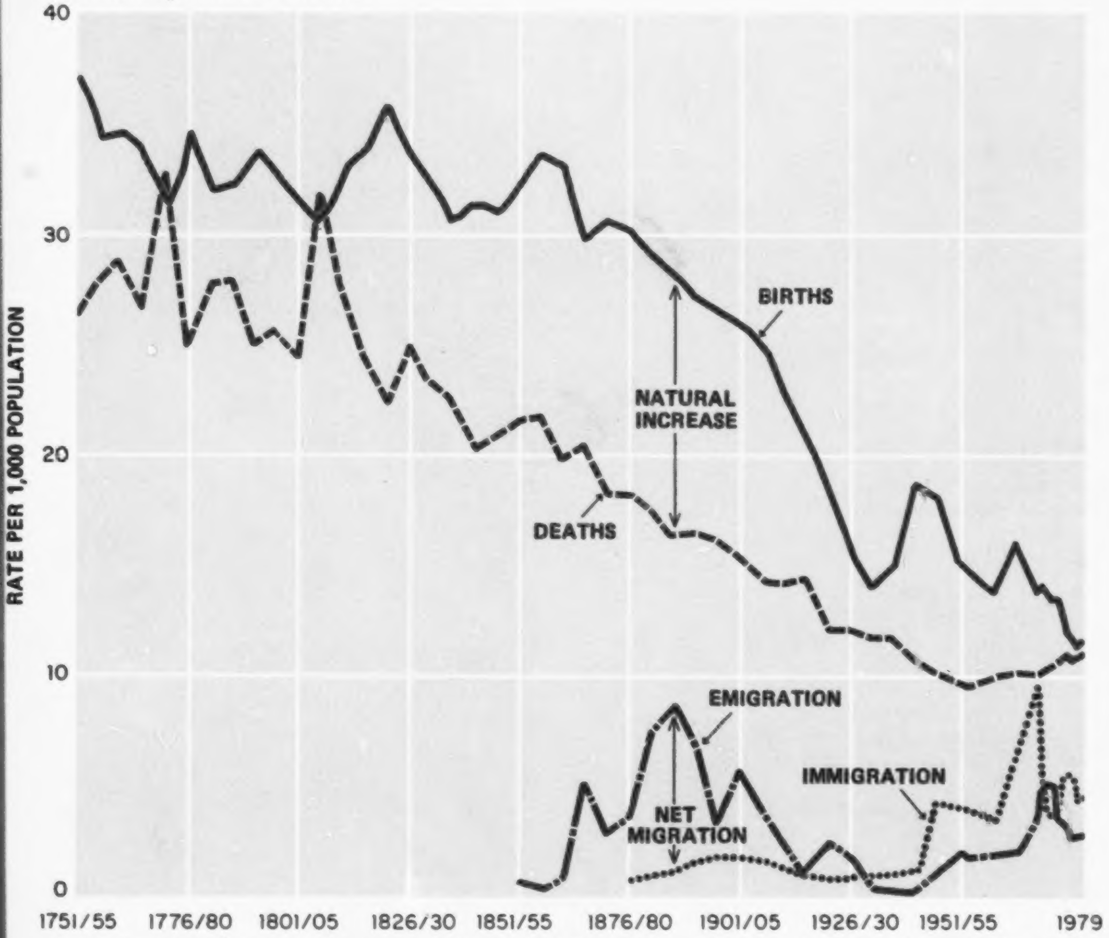
Sweden, together with Finland, has been collecting national population statistics continuously since 1749, longer than any other country in the world. The population totaled just under 1.8 million at that time. For the next two centuries it grew at an average long-run rate of about 7 per 1,000 people or 0.7 percent per year, a rate that doubles a population's numbers in 100 years. Thus in 1850 the population was 3.5 million and doubled again to 7.0 million a century later in 1950. Since then, the growth rate has varied widely, with low levels being reached in the 1970s. In 1979 it stood at just 2.3 per 1,000 or 0.2 percent, as seen in Table 1. Sweden's 1980 population is estimated at 8.3 million.

Population growth is determined by the difference between annual births and deaths (natural increase) and between immigrants arriving in a country and people moving out (net migration). Shifting trends in these four factors have added up to considerable fluctuations in Sweden's historical population growth even though that growth has averaged out broadly to about the same over most of the two and a quarter centuries since 1750. Table 1 gives the details on rates of natural increase, net migration, and total population increase together with population size by half century from 1751 to 1950 and for specified years since then. The trends in birth, death, and migration rates are illustrated in Figure 1.

From 1751 to 1800, the birth rate averaged a relatively high 34 per 1,000 population (similar to the current rate in Mexico, for example, where the birth rate has fallen sharply in recent years) and the death rate was only about 6 points lower. (There is no reliable estimate of migration until the mid-19th century.) The next half century saw the start of Sweden's long-term demographic transition from high to low birth and death rates. The death rate began its sustained decline (although this was interrupted by epidemics as seen in Figure 1), initiating the rapid-growth phase of the transition. But the drop in mortality was modest, and with the birth rate also falling slightly, the rate of natural increase went up only from 6 to to 8 per 1,000.

It was in the latter half of the 19th century that the rate of natural increase

Figure 1. Birth, Death, Immigration, and Emigration Rates: Sweden, 1751-1979



Source: Carl Johan Åberg and Allan Nordin, *Befolkning och ekonomi* [Population and the Economy] (Stockholm: Trygg-Hansa, 1977) Diagram 3.1., p. 23, updated from data in Table 1.

accelerated to its half-century peak of 11.5. As a result, "overpopulation" built up in the poor rural areas, as in many other European countries at the time. The response was an epidemic of "America fever"—particularly during the 1880s and 1890s. With the large volume of emigration, the actual rate of population growth averaged just under 8 per 1,000 from 1851 to 1900, about the same as in the preceding half century. Another important development during this period was the beginning of the sustained decline in fertility, about 1880.[3]

The main features of Sweden's demographic history since 1900 are a continuing fall in the birth rate to very low levels, relieved by some upward movement in the 1940s and 1960s, and a marked shift in the migration balance from emigration to immigration, particularly after World War II.

During the economic depression and mass unemployment years of the 1930s, emigration dwindled to virtually zero, immigration was scarcely higher, and the birth rate dropped to a low of about 14 per 1,000. With the death rate down to 11.7 per 1,000 by this time, population growth averaged a very low 0.4 percent per year.

The birth rate climbed again with improving conditions in the 1940s and again in the early part of the 1960s. Since the 1965 level of close to 16 per 1,000, however, it has dropped almost uninterruptedly, reaching an alltime low of 11.3 in 1978 and then rising a bit to 11.6 in 1979. (The lowest recorded birth rate prior to this was 13.7 in 1933 and 1934.) The death rate, meanwhile, after fluctuating around 10 per 1,000 in the 1950s and 1960s, rose after 1970, despite continued declines in age-specific death rates. This is because an increasing proportion of Sweden's population is now composed of the elderly among whom death is more likely. In 1979, the death rate stood at 11.0 per 1,000. Thus Sweden's rate of natural increase in 1979 was 0.59 per 1,000 population, or less than 0.1 percent.

This low figure is matched by most of Sweden's neighbors. Natural increase averaged 0.1 percent in Northern and Western Europe in 1978. The only major exceptions were Iceland at 1.2 percent and Ireland at 1.1 percent. Although also dropping in other developed regions of the world, the rate of natural increase in 1978 was a higher 0.7 percent in Southern and Eastern Europe and in Canada and the United States. In the U.S.S.R., Australia, and New Zealand, it was 0.8 percent, and in Japan, 0.9 percent. In *less* developed countries as a whole, natural increase now averages 2.0 percent.[4]

That Sweden's population growth rate has not yet turned negative is thanks almost entirely to immigration. Immigration began to outstrip emigration already in the 1930s, but not substantially so until after World War II when the economy began to expand and Sweden sought workers from abroad (see Figure 1). Since 1950 there has been a net migration gain every year except 1972 and 1973. Fluctuating with the Swedish business cycle, the gain has ranged generally between 1.0 and 2.5 per 1,000 population. From 1944 through 1977, 29 percent of the Swedish population growth of 1.74 million was accounted for by net immigration. The natural increase of the immigrants, it has been estimated, produced an additional 17 percent of the growth. Thus, almost half of Sweden's population increase between 1943 and 1978 resulted directly or indirectly from net immigration. And during the 1970s, with natural increase reduced almost to zero, the net gain from international migration has come to account for much more of population growth than has natural increase. This is unprecedented.

Population projections 1978-2025

In its most recent population projections, the Swedish National Central

Bureau of Statistics uses three alternative assumptions in projecting fertility and two in estimating future migration.[5] Only one trend was selected for mortality, since it was assumed that age-specific death rates would remain unchanged from 1977, except for slight declines between 1977 and 1985 among men over 80 and women older than 50. As a result, average life expectancy is projected to increase only from 72.1 in 1977 to 72.2 years in 1985 for males and from 77.9 to 78.6 for females and remain constant thereafter.

One of the migration assumptions supposes an annual net gain of 10,000 throughout the 1978-2025 projection period, resulting from an annual immigration of 35,000 and emigration of 25,000. The other alternative assumes the same annual gain for 1978-1984 but zero net immigration from then on as a result of an annual balance of 30,000 immigrants and 30,000 emigrants. This second alternative is regarded as more likely.

The medium and main alternative for fertility assumes that the total fertility rate (TFR) will increase from 1.64 births per woman in 1977 to 1.80 in 1985 and remain constant thereafter to 2025. (The total fertility rate is explained in the next section.) The high alternative calls for the TFR to increase to 2.1 (the replacement level) by 1985 and the low alternative assumes a continued decline to 1.5 by 1985. Both would then stabilize at those levels to the end of the projection period.

The effect of the main assumptions (a TFR of 1.8 and zero net immigration) is that Sweden's population is expected to inch up only from 8.27 million at the end of 1977 to a maximum of 8.36 million by the end of 1986. From then on the numbers would decline, reaching 8.27 million—the 1977 figure—by the beginning of the next century. Then the decline would accelerate so that by 2025 there would be less than 7.8 million people in Sweden. If the low 1.5 TFR assumption were to materialize, with no net immigration, there would be 7.9 million by the turn of the century and less than 7 million by 2025. With an annual net immigration of 10,000, these totals would be larger by about 200,000 in 2000 and 400,000 in 2025.

To fill in the details of this population picture, we turn first to recent fertility trends.

Fertility Trends

As noted, Sweden's crude birth rate (CBR) fluctuated after the lows of the early 1930s: up during the 1940s, down again somewhat in the 1950s, and up in the early 1960s. Since 1964 it has fallen almost uninterruptedly from just over 16 births per 1,000 population to 11.6 in 1979.

The crude birth rate is determined by the number of women in the childbearing ages—ages 15 to 44 or 49—and by the rate at which these women reproduce. The number of annual births per 1,000 women in the childbearing ages is called the general fertility rate (GFR). The decline in Sweden's CBR since 1964 has resulted from a pronounced drop in the GFR. In 1956-60, the GFR was 71.2 births per 1,000 women aged 15-44. It then rose to about 79.5 in 1964-66. But by 1978 it had fallen to 56.7. (In the United States in 1978, the GFR was 66.4.) Because of the higher birth rates of the 1940s, the number of women in the reproductive ages began to rise as from the mid-1960s. If the GFR had remained constant at the 1964 level of 79.5, there would have been 131,000 births in 1978 rather than 93,000—about 40 percent more. Correspondingly, the CBR would have been 15.9 per 1,000 population instead of 11.3.

A better measure than either the crude birth rate or the general fertility rate for tracing fertility trends over time is the total fertility rate (TFR). This measure is the sum of the rates at which women in each single year of age from ages 15 to 44 or 49 bear children in a

Table 2. Age-Specific and Total Fertility Rates of Swedish Women: 1901-1978

(Births per year per 1,000 women)

Period or year	Age of women							Total fertility rate per 1,000	Total fertility rate per woman
	15-19	20-24	25-29	30-34	35-39	40-44	45-49		
1901-05	15.9	119.5	193.3	193.6	159.7	87.8	11.4	3,906	3.9
1906-10	18.9	121.9	186.3	186.5	149.3	78.9	10.0	3,759	3.8
1911-15	19.5	113.3	163.3	158.3	130.4	69.2	8.1	3,331	3.3
1916-20	16.9	105.5	148.7	140.0	111.0	58.7	7.3	2,941	2.9
1921-25	17.9	97.2	132.2	120.3	93.5	48.2	6.0	2,577	2.6
1926-30	17.8	83.0	106.3	95.0	72.6	36.5	4.4	2,078	2.1
1931-35	17.8	76.2	93.4	80.8	56.1	25.7	3.0	1,765	1.8
1936-40	19.9	83.6	100.4	83.2	53.4	21.8	2.3	1,823	1.8
1941-45	25.6	111.4	134.0	107.5	66.8	23.6	1.9	2,354	2.4
1946-50	36.4	127.4	138.0	103.1	62.1	22.0	1.8	2,454	2.5
1951-55	37.8	128.2	128.3	86.8	47.8	15.9	1.3	2,231	2.2
1956-60	36.7	132.5	136.9	85.5	42.3	12.9	0.9	2,239	2.2
1961-65	42.8	136.9	148.9	87.6	39.3	10.7	0.7	2,335	2.3
1966-70	41.9	127.2	137.3	77.1	32.2	7.6	0.5	2,119	2.1
1971-75	32.0	121.8	128.7	67.0	23.6	4.7	0.2	1,890	1.8
1975	28.8	115.0	123.3	64.1	20.7	3.7	0.2	1,779	1.8
1976	25.0	107.1	118.8	62.4	20.5	3.6	0.2	1,688	1.7
1977	22.1	103.6	117.9	61.5	20.7	3.6	0.2	1,648	1.6
1978	19.2	97.1	116.0	62.4	21.6	3.7	0.1	1,601	1.6

Sources: 1901-1975: National Central Bureau of Statistics, *Population Projection for Sweden 1976-2000 (Information i prognosfrågor 1976:3)* (Stockholm: 1976) p. 11; 1975-1978: National Central Bureau of Statistics, *Population Changes 1978*, Part 3 (Stockholm: 1980) Table 3.16.

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given year (or the sum of the rates by five-year age groups multiplied by 5). Since these age-specific rates are all expressed as the number of births per 1,000 women in each age category, the TFR—unlike the GFR—is not influenced by how many women there happen to be in a given year in the 20-29 year-old age group, the ages at which age-specific fertility rates are generally highest. Nor is the TFR influenced by how many women there are altogether aged 15 to 44 or 49 in that year, which affects the crude birth rate.

From Table 2 we see that Sweden's TFR fell from 3,900 per 1,000 women 15-49 years old at the beginning of the 20th century to less than half that rate, about 1,800, during the 1930s. It then rose to a peak of 2,450 in the late 1940s, sagged a bit in the 1950s, and climbed back to over 2,300 in the early 1960s. It has been falling ever since. In the early 1970s, the TFR was about 1,900. By 1978, it was down to an all-time low of 1,600, or 1.6 per woman. (The U.S. total fertility rate in 1978 was 1,765 per 1,000 women aged 15-44, or just below 1.8 per woman.)

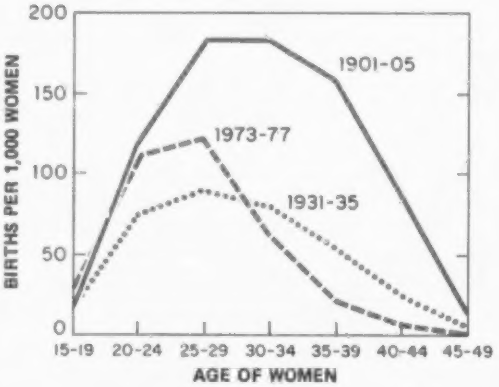
If Swedish women were to continue to bear children at the rate that all women in the reproductive ages actually did in 1978, each would end up with an average well below the level necessary to exactly replace each adult in the population. An annual TFR of 2.1 children per woman would have to be sustained in order for births and deaths to be in balance under the low mortality conditions prevailing in Sweden, leaving migration out of account. (Why not 2.0—one child for each parent? Because, to ensure replacement, every woman on average must have a daughter and for every 100 female babies born alive in Sweden there are 106 male infants born alive, an average of 206 boys and girls per 100 women, or 2.06 per woman. In addition, compensation must be made for the few female infants who fail to survive to reproductive age.)

The TFR was also below replacement level in the 1930s but rose above replacement in the next three decades. The current TFR of about 1.6, however, is more than 10 percent below the 1.8 of the 1930s and one wonders if Sweden's TFR will again climb to replacement level. As we have seen, the current "medium" official population projection, regarded as the most likely, assumes that the TFR will rise slightly to 1.8 in 1985 and remain constant thereafter. If that happens, overall annual births would dip below deaths already in 1986 and if the loss is not made up by net immigration, the country's population would begin to decline.

Childbearing concentrated

Table 2 also shows that the age pattern of Swedish women's fertility has changed markedly. By the 1970s, childbearing had become concentrated among women in their twenties. Except during the 1940s, age-specific fertility rates among women 35 and over have declined steadily throughout the 20th century and were almost nil among women in their forties by the early 1970s. Although not quite as pro-

Figure 2. Age-Specific Fertility Rates: Sweden, 1901-05, 1931-35, 1973-77



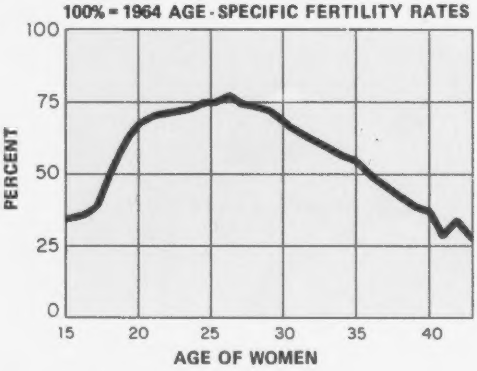
Source: National Central Bureau of Statistics, *Population Projection for Sweden 1978-2025 (Information i prognosfrågor* 1978:5) (Stockholm: 1978) Diagram 2.4, p. 12.

nounced, the decline was similar among women 30-34 years of age. Among women aged 15-19, fertility rates rose in the decades following the 1930s but by 1978 had fallen back to the low levels of the early 20th century.

As may be seen in Figure 2, the change between the beginning of the century and the low point of the early 1930s was mainly the large drop in the overall level of fertility. There was only a modest shift in the age pattern of childbearing toward women aged 20-29. Between then and the mid-1970s, however, fertility became markedly concentrated in this age group. The TFR was about the same in the 1973-77 period as in 1931-35.

Figure 3 shows details on this shift for 1964-77. For women aged 20-29, fertility rates in 1977 were about 75 percent of what they were in 1964. For older and younger women, however, the drop was much greater. By 1978, only 5.4 percent of total Swedish births were accounted for by teenage women, a remarkably low figure compared to the U.S. where 17 percent of all births in 1977 were to teenagers.[6] Two-thirds of all Swedish births in 1978 occurred to women in their twenties (Table 3). For mothers and babies, these are the most favorable ages for childbearing and this concentration has played a role in reducing the Swedish infant mortality rate to the lowest in the world (see later section on "Mortality Trends").

Figure 3. 1977 Age-Specific Fertility Rates as Percentage of 1964 Rates



Source: See Figure 2, Diagram 2.6, p. 13.

Cohort versus period fertility

The TFR for a given year or period is not the same as the completed fertility rate—the number of children which a group of women born at the same time (a birth cohort) actually had on average by the end of their childbearing years at about age 50. As seen in Figure 4, actual completed fertility in Sweden has hovered around 2 births per woman from the 1895 birth cohort onward. The level was below this for women born in the first decade of this century who were in their prime childbearing years during the Depression years of the 1930s and slightly higher for women born between 1920 and 1935 whose childbearing came mostly in the 1940s, 1950s, and early 1960s. It is too soon yet to know what the final average will be for women born from 1945 on. So far, however, they

Table 3. Distribution of Births by Age of Mother: Sweden, 1955-1978

(Percent of total births)

Age of mother	1955	1960	1965	1970	1976	1978
Under 20	7.8	9.5	12.1	8.3	6.6	5.4
20-29	55.7	57.9	62.1	69.9	68.0	65.6
30 and over	36.5	32.7	25.8	21.8	25.4	29.0

Sources: 1955-1976: United Nations, *Demographic Yearbook*, various editions; 1978: National Central Bureau of Statistics, *Population Changes 1978*, Part 3 (Stockholm: 1980) Table 3.3.

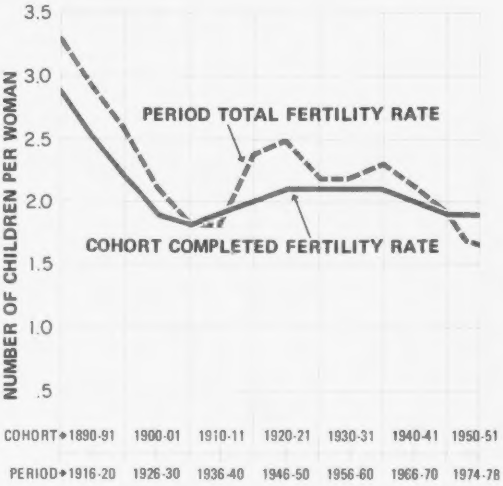
have had fewer births in their twenties than women born just before them and it is likely that they will average a completed fertility rate that is again just below 2 births per woman.[7]

Sweden's TFR has varied much more sharply than the cohort completed fertility rate, as also seen in Figure 4. In contrast to the *completed* fertility rate of a birth cohort of women, the TFR is a "period" measure which sums up the childbearing experience of all women from different birth cohorts who happen to be in the childbearing ages in that period or year. It is thus affected by the *timing* of cohort fertility, or the ages at which women are having children. Because the TFR reflects the birth rates of a particular period, it is more directly related to the rate of population growth of that period than the cohort completed fertility rate.

During the early 1930s, Sweden's TFR fell as a result of a decline in age-specific fertility rates at all ages, as seen in Table 2. As economic conditions improved, women who had delayed childbearing made up for lost time and age-specific rates rose among older women. For example, in 1931-35, women then aged 20-24 had a fertility rate well below the rate of women that age five years earlier—76.2 compared to 83.0 births per 1,000. Five years later (1936-40), these same women at ages 25-29 had a higher rate than women that age had had in the preceding five years—100.4 versus 93.4. And their fertility in 1941-45 at ages 30-34 was again higher than that of women born immediately before them—107.5 compared to 83.2.

Younger women (born in the 1920s) also responded to improved economic conditions in the later 1930s and 1940s with higher age-specific birth rates than women in their twenties had during the Depression. The result of this overlapping of the two age patterns of childbearing was an increased TFR during the 1940s—considerably higher than the completed fertility which these different cohorts of women eventually had.

Figure 4. Period Total Fertility Rate and Cohort Completed Fertility Rate: Sweden, 1890-1978



Source: National Central Bureau of Statistics, *Barn—behov eller börda?* [Children—need or burden?], *Urval* No. 11 (Stockholm: 1979) Diagram 3.1, p. 34.

The downswing in the TFR in the 1950s was partly the result of the previous increase. Women who had advanced their childbearing into their twenties during the 1940s tended to offset this by lower age-specific fertility rates at older ages than women born just before them. The same trend probably explains something of the downturn in the TFR since 1964. Fertility rates among women in their twenties continued to increase until 1965 (Table 2) and were quite likely to decrease later among these same women as they grew older. Since 1965, however, the TFR has also been depressed by a decline in fertility rates among women in their twenties—those women born in the late 1940s and 1950s. It remains to be seen if this decline represents a delay in childbearing that will later be made up—as happened among older women in the 1940s—or if these women will end up with a completed fertility rate lower than that of any cohort before them. Also uncertain is what the timing and level of fertility will be among women entering their childbearing years during the 1980s and 1990s.

Besides shifts in the timing of childbearing, another important demographic factor underlying TFR trends of the past four decades is Sweden's changing pattern of marriage.

Marital Status

In most societies births occur preponderantly within marriage and fluctuations in the proportion of men and women who are married, especially in the prime reproductive ages, have a considerable impact on fertility. The marked changes in this proportion in Sweden during this century parallel trends in the fertility rates.

Up through 1930, only one-fifth of women aged 20-24 were married and not quite half of women aged 25-29, as seen in Table 4. This reflects Sweden's long tradition of late marriage and much celibacy. During the next two decades, however, the proportion married doubled from 19 to 40 percent among women aged 20-24 and went up by half—from 48 to 72 percent—among women aged 25-29. A more modest increase took place during the 1950s. By 1960, more than three-quarters of women 25-29 were married.

Table 4. Percent of Women Married at Ages 20-24 and 25-29: Sweden, 1900-1978

Year	Age of women	
	20-24	25-29
1900	19.5	47.5
1910	20.1	48.2
1920	19.6	47.9
1930	19.4	47.7
1940	28.2	59.6
1950	39.8	71.7
1960	43.7	77.7
1970	38.2	73.2
1975	23.7	60.1
1976	22.6	57.7
1977	20.8	55.0
1978	18.8	52.0

Sources: National Central Bureau of Statistics (NCBS), *Historical Statistics of Sweden*, Part I: *Population 1720-1950* (Stockholm: 1955) pp. 25-26; NCBS, *Population Changes 1976*, Part 3 (Stockholm: 1977) Table 1.4; NCBS, *Population Changes 1978*, Part 3 (Stockholm: 1980) Table 1.4.

Beginning around the middle of the 1960s, there was a strong reversal back to old marriage patterns. By 1978, the percentage married in these two age groups had dropped to the levels of 1930. The 19 percent married among women 20-24 in 1978 is remarkably low compared to the United States where 51 percent of women that age were or had been married in 1979[8]—the lowest proportion on record for this country.

The shifts in the proportion married are reflected in age at marriage. In 1930, 25.2 was the median age of women at first marriage (half were younger and half older). By 1950, the figure was down to 23.9 and in 1960 it was 22.8. By 1978 it was back up to 24.9 (compared to 21.8 in the U.S. in that year).[9]

The increase in marriage between 1930 and 1960 accounts for much of the rise in age-specific birth rates of all women in their twenties in that period. The sharp fall in the percentage married at these ages since the mid-1960s has also had an appreciable effect, but in the opposite direction.

One reason for these effects is that the age-specific birth rates for all women are the weighted averages of the rates for married and unmarried women. In Sweden, as in most other countries, marital fertility rates among women 20-29 are much greater than the out-of-wedlock rates, as seen in Table 5, although the difference between them narrowed during the 1970s. From the late 1930s to the late 1960s, marital fertility rates for women remained essentially unchanged but because of the increase in the proportion married at these ages, the relative importance of these higher rates increased. As a re-

Table 5. Marital and Non-Marital Fertility Rates for Swedish Women Aged 20-24 and 25-29: 1936-1978

(Births per year per 1,000 women)

Period or year	20-24		25-29	
	Unmarried	Married	Unmarried	Married
1936-40	25	261	17	170
1946-50	31	281	24	186
1956-60	30	267	26	172
1966-70	41	243	34	170
1971-75	68	247	62	161
1976	67	239	69	154
1977	67	237	71	155
1978	63	234	71	155

Source: National Central Bureau of Statistics, *Population Changes 1978*, Part 3 (Stockholm: 1980) Table 3.16.

sult, age-specific rates of all women 20-24 and 25-29 rose considerably in this period.

During the 1970s (through 1978), there was a modest fall in marital fertility rates for these ages and a steep fall in the proportion married. The resulting decline in age-specific fertility rates for all women—from 127 to 97 per 1,000 women aged 20-24 and from 137 to 116 for women 25-29 (Table 2)—would have been much greater if not moderated by a sharp rise in the rates for unmarried women. Fertility rates among unmarried women aged 20-24 rose from 41 to 63 per 1,000 between the late 1960s and 1978 and more than doubled from 34 to 71 among unmarried women aged 25-29 (Table 5).

Non-marital cohabitation

The decline in marriage in Sweden has not meant a commensurate decline in numbers of unions. Beginning sometime during the 1960s, there has been a rapid increase in the popularity of de facto unions. This is not a new phenomenon in Sweden. Consensual unions were quite common in some rural districts in the late 19th and early 20th centuries. They were also frequent among the poor in Stockholm, so much so that they were dubbed "Stockholm marriages."[10] How frequent such unions were throughout the country is not known.

As recently as the 1950s, however, only an estimated one percent of cohabiting couples in Sweden were unmarried. But at the end of the 1960s the proportion was up to 7 percent. The 1975 census reported about 11 percent, a figure the National Central Bureau of Statistics believes is probably too low. In 1978, a government report put the figure at 15 percent.[11] The sudden increase in de facto unions is not peculiar to Sweden but among countries for which there are recent estimates, the level is highest in Sweden. It was 13 percent in Denmark in 1977, 8 percent in Finland in 1978, and much lower, though increasing, in Norway, France, and the United States (2.3 percent in 1978).[12]

So far, non-marital cohabitation has been adopted mainly by young adults, as seen from the 1975 census data shown in Table 6. Among all persons living in a union, the proportion unmarried at ages 20-24 was more than double the level for those in their later

Table 6. Percent Unmarried of All Women and Men in Union: Sweden, 1975

Age	Women	Men
20-24	57	71
25-29	23	35
30-34	10	14
35-39	6	8
20 and over	11	11

Source: National Central Bureau of Statistics, *Barn—behov eller börda?* [Children—need or burden?], *Urval* No. 11 (Stockholm: 1979) p. 42.

twenties (57 compared to 23 percent for women and 71 versus 35 percent for men), and diminished rapidly with increasing age. Close to 30 percent of all women aged 20-24 were living in a non-marital union in 1975 and only 22 percent were married. In 1965, 40 percent of women in their early twenties were married. (The 1965 census did not ask about non-marital cohabitation.) Among men aged 20-24, 19 percent were cohabiting and only 8 percent were married in 1975; 18 percent of men this age were married in 1965.[13]

Sweden has long had a permissive attitude toward premarital sex. This has its roots, according to Alva Myrdal, in a historical rural custom that tolerated premarital sexual relations under specific conditions such as "night courtship."[14] The permissive tradition was later enhanced by "the far-reaching secularization of Sweden that occurred along with industrialization in the late 19th and early 20th centuries," and particularly the egalitarianism of Swedish society. As sociologist Richard Tomasson puts it: "When women's roles are characterized by a high level of equality with men [as they are in Sweden]. . . . there is likely to be a permissive sex ethic."[15] And he points out that sex education—which now stresses the social and ethical as well as biological aspects of sex[16]—has been compulsory at all grade levels in Swedish schools since 1956.

These factors alone, however, can hardly explain why so many young Swedish couples have suddenly taken to actually living together without benefit of matrimony. Swedish demographer Erland Hofsten sees the "growing mobility" of the population, more available housing, and the "rapidly growing independence of women, visible in the increasing number of economically active women" as important in "making the situation ripe for a change in marriage habits."[17] But to explain the suddenness of the change, he adds, "we must obviously look for something which occurred in the late 1960s." Danish demographer Mogens Boserup stresses here the "new youth movement" which swept Western nations, challenging "traditional rules . . . with regard to social behavior."[18] More important, Hofsten feels, were liberalization of abortion and the introduction about this time of efficient contraceptives such as the pill, "easy to apply and available to all [which] imply that sexuality finally and conclusively is disassociated from procreation. When it becomes clear to young people that they can live together without any risk of an unwanted pregnancy, this must have consequences for the behavior of young men and women. Why marry, if a child is not planned anyway for the time being? And if it proves possible to live in a consensual union without marrying, why not continue to do so also after a child has been born?"[19]

That many young Swedish people may view cohabitation as trial marriage is suggested by a 1975 survey of unmarried couples in their twenties in the neighboring country of Denmark. About one-third said they regarded living together as a period of experimentation and about one-seventh indicated that it was economically an advantage; but another third simply felt legal formalities were unnecessary.[20]

Fertility among cohabiting Swedish

women is about half that of married women to judge from 1975 census data. The average number of children already born per woman was:[21]

Age	Married (living with husband)	Cohabiting
20-24	1.0	0.5
25-29	1.6	0.8
30-34	2.0	0.9

So long as informal unions are viewed as trial marriages and likely to be unstable, this differential is bound to persist. Thus the increasing preference for such unions, if it also persists, could further depress the birth rate.

Out-of-wedlock births

It would also mean a continued increase in the proportion of out-of-wedlock births. Only a tenth of births were out of wedlock in the 1940s and 1950s. The figure rose during the 1960s and was about 18 percent in 1970. In the next eight years there was a doubling to 36 percent in 1978.[22] This figure was a much lower 16 percent in the U.S. in 1978 although the proportion of out-of-wedlock births has also risen rapidly in this country in the past decade or so.[23]

It should be noted that the stigma attached to out-of-wedlock births has long been much less in Sweden than in the U.S. The stigma has weakened in both countries but the gap has not closed. Recording of births by legitimacy status is still required in most U.S. states but has been abolished in Sweden, for example. And Swedish children born outside marriage have the right to receive maintenance from both parents, inherit from both, and adopt either surname. They and their parents receive all social welfare family benefits. There is even an "advance allowance" of 4,700 crowns a year (about $1,100) paid to a child of unmarried (or divorced) parents who lives with only one of them, in case the other parent does not contribute at least this amount.

Divorce

A rapid rise in divorce up to 1975 undoubtedly also played a role in the birth rate decline. For every 1,000 married women aged 30-34, for example, there were 7.4 divorced in 1962, 7.9 in 1965, and 10.9 in 1970. Then the rate more than doubled to 24.5 in 1975 but subsided to 19.6 in 1978. An easing of the divorce law at the beginning of 1974 explains much of the acceleration in the mid-1970s. Divorces went up sharply from 16,000 to 27,000 between 1973 and 1974 and then fell back to 20,000 in 1978.[24] Cohabitation could help lower the divorce rate further in future years if this growing practice serves to prevent many couples from entering into incompatible marriages.

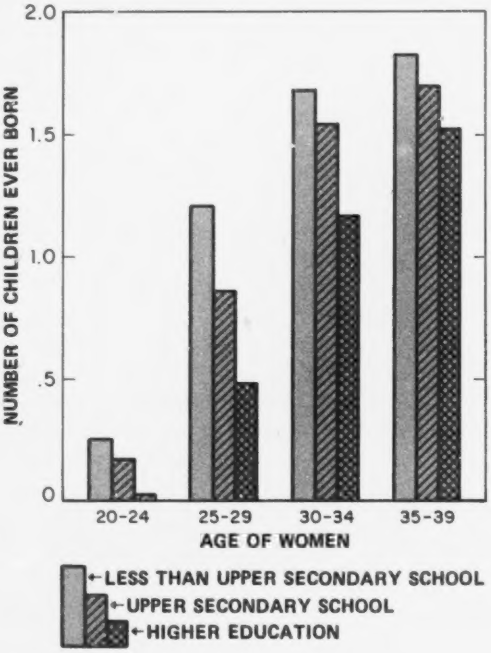
The late 1960s and 1970s have clearly been a watershed period in Sweden with the rapid retreat from legal marriage, the rise in informal unions (accompanied by inflation of the proportion of out-of-wedlock births), and increasing separation of sexuality from reproduction. These trends that have helped depress annual births virtually to the level of deaths are very likely related to the increase in women's education and particularly their increased employment outside the home.

Women's Changing Status

Wherever women's chances for education and gainful employment have come close to those of men around the world, lower birth rates have been the almost inevitable result. In stressing equal rights for women, Sweden has had few rivals.

One observer commented at the end of the 1960s: "A self-conscious ideological emphasis on equality between the sexes in work, education, and in all official areas characterizes Swedish society."[25] During the 1970s, two government committees on equality went

Figure 5. Average Number of Children by Women's Educational Attainment and Age: Sweden, 1976



Source: See Figure 4, Diagram p. 3.14, p. 75.

beyond this to encourage equality also in family life. Legislation has been enacted to encourage men to share childrearing responsibilities. The official theme is that "Both women and men must be enabled to play double roles, i.e. take active part in both family life and working life."[26] New programs have also been designed to draw more women into traditionally male occupations and more men into health and social services and preschool teaching.

In practice, the stress on equality has worked best in the educational sphere and less so in the work world and in the home.

Increasing education

Sweden has nine years of compulsory schooling from the age of seven and virtually all children are enrolled. Enrollment beyond that has increased sharply in the post-World War II period. Among 16-18 year-olds, the proportion attending school rose from 10 to over 60 percent between 1940 and 1970. And among young men and women aged 19-24, the percentage enrolled in colleges and universities went from a mere 5 percent to 30 percent in those 30 years.[27]

Women shared fully in those increases. By 1975, girls aged 16-19 averaged slightly more years of schooling (10.0) than boys that age (9.6).[28] And in both 1965 and 1975, girls were in the majority among new entrants to colleges and universities. Deliberate efforts are made to break down traditional sex-role differences. Boys and girls alike must study domestic science and child care as well as woodworking and metalwork in primary school and a 1975 government report urged that technology be compulsory for girls and that boys should be exposed to nursing in upper grades.[29] When they have a choice, however, young women still lean toward traditional "female" fields and in university tend to choose shorter courses than young men do.

Nevertheless, the continuing increase in educational attainment is likely to reinforce both the decline in fertility and the trend toward increasing proportions of working women. In Sweden, as in the U.S., the more education women have, the lower the average number of children (Figure 5). The relationship between education and employment is strongly positive. Eighty four percent of women aged 25-64 with more than two years of college or university education were working in 1970 compared to only 54 percent of those with less than the nine compulsory years of schooling (Table 7).

Increasing employment

Women's employment rates have soared in all Western nations in the second half of the 20th century. But in Sweden, the flood of women into the paid work force

Table 7. Percent of Swedish Women Aged 25-64 in the Labor Force, by Educational Attainment: 1970

Educational attainment	Percent in labor force
Less than 9 years	54
At least 9 years	61
Upper secondary school	65
Up to 2 years college or university	72
More than 2 years college or university	84

Source: The Joint Female Labour Council, *Woman in Sweden in the Light of Statistics* (Stockholm: 1973) Table 3.7, p. 39.

has outstripped that of most countries.

In 1930, less than a third (31 percent) of Swedish adult women were working, and the proportion declined in the next two decades as marriage rates increased and it remained unfashionable for married women to work. After 1950, however, women's labor force participation rates escalated, reaching over 72 percent among women 16-54 in 1976. In the U.S. in 1978, the rate was 60 percent in the same age group.[30]

Married women and mothers have been in the vanguard of the change. In 1950, only 15 percent of married Swedish women were working or looking for work outside the home. By 1975, a quarter century later, that figure had quadrupled to 60 percent—considerably higher than the 48 percent of U.S. married women in the labor force in 1978. In Sweden, as elsewhere, the more children a woman has and the younger they are, the less likely she is to take a job away from home. Yet the employment rates of mothers of preschool children (under age seven) have increased more rapidly than those of all other women. From the mid-1960s to 1977, the proportion of such mothers who were working went up dramatically from 37 to 66 percent. In 1978 in the U.S., the rate for mothers of preschool children was 42 percent—also representing the swiftest rise in employment rates among all women in recent years.

Continued rapid increase in Swedish women's employment rates are expected. Among mothers aged 20-44 alone, for example, projections for proportions employed range from 72 percent (for those 35-44) to 81 percent (for those 25-34) as early as 1983.[31]

The long-run increase in Swedish women's employment is related to a number of demographic, social and economic changes. As birth and death rates declined, women have had more years to work outside the home after the last of their children passes the ages requiring most maternal attention and have lived longer to take advantage of these years. Women have been more in demand in the labor market as men's employment rates have fallen: with increasing education, young men have been starting work at later ages and after the introduction of pensions in the 1930s and 1940s, older men began retiring earlier than they once did. By 1976, women made up 43 percent of the labor force, up from 35 percent in only the six years since 1970.[32]

There has been tremendous growth in the kinds of jobs that traditionally appeal to married women or for which employers are most likely to hire women: public service jobs especially, office work, and jobs that permit part-time schedules. In recent years, day-care facilities have expanded and tax rules have been changed to permit couples to file separate tax returns, thus lowering their tax rate in Sweden's steeply progressive income tax scale. And with all these changes, coupled with the emphasis on equality for women, social attitudes have changed radically regarding the propriety of wives and mothers going to work outside the home.

Going to work, however, has not guaranteed women economic equality with men. This is primarily because Swedish working women—like their counterparts in the U.S.—are disproportionately concentrated in less remunerative jobs. In 1975, close to half (49 percent) of women in the labor force were employed in relatively low-paying service jobs as secretaries and office workers, nurses, teachers, saleswomen, public health and social workers, and the like. Only 17 percent of employed men worked in the service sector. Just 5 percent of working women had "independent or managerial tasks" in 1975 against 50 percent of employed men.[33] In some professions, however, Swedish women comprise fairly high proportions to judge from the following comparisons with the U.S.:[34]

	Percent female	
	Sweden 1975	U.S. 1977
Lawyers	12	9.5
Physicians	23	10.6
Dentists	30	2.9
Pharmacists	82	17.4

Sweden has also made efforts to guarantee equal pay for equal work. Among industrial workers, for example, the average hourly wage earnings of women increased from 75 percent of men's in 1965 to 86 percent in 1974.

The Swedish Institute: Photo by Hans Hammarsköld

An architect for the City of Stockholm. Swedish married women have flooded into the work force in recent years but relatively few hold well-paid professional jobs.

Constraints and Supports for Women's Dual Role

Clearly Swedish women—like their American sisters—are increasingly opting to both work and have children, just as official policy now holds that they should. Outside employment no longer appears to be as incompatible with motherhood as it once was. But there are still constraints to combining childrearing with employment that make it likely that most Swedish women will continue choosing to have only one or two carefully timed children.

Unlike the U.S., Sweden has a comprehensive public program of day care for small children for which parents pay from 3 to 25 crowns per day, depending upon income.* There are also "leisure centers" for before- and after-school care of older children of working parents, and kindergartens for six-year-olds were introduced in 1975. In 1965, there were places for only 23,000 children in such centers. Thereafter the number expanded rapidly and reached 221,000 in 1977, not including places in kindergartens for six-year-olds. In 1976, there were only 60,000 places in day-care centers for children under six. Plans called for adding 100,000 by 1980.[35] Doubtless the increase in child-care facilities had much to do with the enormous increase between 1965 and 1977 in employment among mothers of preschool children. But in 1977 there were 370,000 mothers of preschool-age children (under seven) in the labor force. Obviously, many of these women had to find other means of child care while they worked. (Sweden is nevertheless far better off in this respect than the U.S. where it is estimated that only 10 to 15 percent of preschool children of working mothers could be accommodated in—mostly private—day-care centers in 1978.[36])

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*1 Swedish crown = 24¢ approximately.

In theory, fathers are now encouraged to share childrearing responsibilities. Under a "parenthood insurance scheme" fathers now receive most of the child-care benefits guaranteed to mothers. Most conspicuous is paternity—or maternity—leave: eight months of leave after a child's birth at 90 percent of salary and another month at a minimum of 32 crowns (about $7.70) per day. Three months can be saved and spread out over the child's first eight years in the form of full or partial days off from work. Fathers as well as mothers can also take up to 18 days paid leave a year to stay home with a sick child, and fathers can receive "sickness" benefits to stay home with older children while their wives (or "cohabs") are in the hospital having a baby. Public offices and businesses are also being encouraged to allow both fathers and mothers of young children to shorten their work day or week at little loss in pay.

In practice, however, equally shared childrearing is still far from reality. In 1978, four years after it was introduced, only 10 to 12 percent of new fathers took paternity leave and most stayed home far fewer days than new mothers did. "A father on paternity leave is still considered an oddity," and a member of the parliamentary Committee on Equality of Men and Women has commented: "Changing attitudes is a very slow job."[37] Employers and the men themselves find it hard to juggle office responsibilities to allow for the part-time absence of men taking paternity leave—most of whom have so far been "well educated and well paid—and thus likely to hold responsible positions," according to a 1979 report to the *Wall Street Journal*. Thus the responsibility for home and children still falls largely on women. Most manage by taking only part-time (and lower paid) work. In 1978, 45 percent of Swedish employed women were working part-time, compared to only 6 percent of men in the labor force—and 29 percent of American working women (in 1980).[38] A 1976 Survey of Living Conditions revealed that husbands of full-time working women help with housekeeping chores more than those of women who work part-time, but in all households, women are still far more likely to do more of those chores than their husbands.[39]

Swedish Information Service

Fathers are now encouraged to share in childrearing but, in practice, women still bear the brunt of child and home responsibilities.

Family allowances and housing

Sweden's "cradle-to-grave" social welfare scheme includes several other measures besides paid paternity/maternity leaves aimed at reducing the burdens of childbirth and rearing. Though first introduced during the low birth rate years of the 1930s, these measures are promoted not on demographic but on egalitarian grounds.

All women giving birth receive free medical care before, during, and after delivery. Most infant, preschool, and school child health care is free, and school children receive a free school lunch. A child allowance of 2,260 crowns ($540) per year is paid to parents for each child under 16. And for each child over 16 attending secondary school there is an annual allowance of 1,600 crowns. University students receive a state study grant of 16,500 crowns a year (nearly $4,000)—2,000 crowns as a scholarship and the rest as a loan. Families are eligible for a state housing allowance according to their income, number of children, and housing costs. For example, a family with two children and an annual income of 50,000 crowns which must pay out a quarter of that income for housing would receive an allowance of about 5,400 crowns a year. In 1974, almost half of all families with children and 90 percent of single parents received this allowance.[40]

The housing allowance is probably one of the most important measures for enabling families to afford additional children. Until recently, housing shortcomings could be seen as a major constraint on fertility in Sweden—both in the number of available dwellings and the size of living quarters. But the situation improved even as the birth rate fell.

Housing shortages were still severe in the 1960s, due to migration to towns, the need for reconstruction in older parts of the cities, and high construction costs. Two-thirds of dwelling units in the "densely-settled" areas where 83 percent of Swedes live were located in "multi-family buildings" or apartment houses in 1975. But, thanks to a special effort, by 1974 over half (56 percent) of families with preschool children and two-thirds (67 percent) of those with children aged 7 to 18 were living in single-family dwellings.[41]

Dwelling units have also increased in size. In 1960, there was an average of only 1.5 rooms per household, not including kitchens. By 1975 the average had doubled to 3 rooms.[42] Swedish families are now also far more likely than they once were to have enough bedrooms to ensure that nobody has to sleep in the living-room—a situation which Swedes, like Americans, are anxious to avoid.[43] Using census data on the number of rooms available in households of families with one, two, or three children and assuming that one of these rooms is a living-room and the rest bedrooms, we have calculated that only 40 percent of families had a separate bedroom for the parents and one for each child in 1960. By 1975, however, the figure was up to 67 percent.[44] In short, the housing situation must be much less of a constraint on fertility than it once might have been.

Birth Control

If Swedish couples are currently opting to have only one or two children, certainly efficient contraceptives and very liberal abortion are now available to help them attain this goal. In the past, as we have seen, late marriage and widespread celibacy were major ways of controlling fertility. But there is evidence that fertility was also controlled within marriage as far back as the early 18th century in some parts of Sweden. Withdrawal, abstinence, and (illegal) abortion were probably the main methods used until fairly recent times. To these were added homemade mechanical devices and, in the first decades of the 20th century, condoms and diaphragms.

The low birth rates of the 1930s are evidence that collectively these methods were effective, although probably with some psychic cost and, in the case of abortion, health risks. With today's birth control methods, Swedish couples are undoubtedly far better able to avoid having more children than they want. Indeed, a 1967 survey found that Swedish women actually had fewer children than they desired. The average ideal number then was 2.4: 1 percent wanted no children; 2 percent wanted one child; 56 percent, two children; 33 percent, three children; and 6 percent, four or more.[45]

Contraceptive methods and practice

Pills were introduced in Sweden in 1964 and IUDs were approved in 1966. The pill was popular right away but Swedish women did not adopt the IUD in significant numbers until the copper spiral was introduced in 1972. Until the 1970s, however, the most readily available of reliable contraceptives was the condom which can be obtained from supermarkets, pharmacies, and vending machines. Pills and IUDs required seeing a physician which meant a private visit at $20 to one of the only 450 gynecologists then practicing in the country or a long wait for appointments at understaffed maternity centers or one of the only two centers run by the Swedish Family Planning Association. In a 1967 national probability survey of 1,600 men and women who were married, engaged, or "going steady," 38 percent of respondents reported having used a condom during their most recent intercourse; 17 percent had used withdrawal and only 14 percent the pill and 1 percent an IUD. Some 27 percent used no contraception.[46] By 1976, it was estimated that about 70 percent of women of reproductive age were using contraception. This was about the same percentage as in 1967 but the methods used had changed radically: 30 percent used the pill; 20 percent, the IUD; 12 percent, the condom; and perhaps 10 percent, traditional methods (including withdrawal) or sterilization.[47]

Before 1976, sterilization was forbidden for men (except for medical purposes) and permitted to women only for medical, eugenic, or "socio-medical" reasons. A new Sterilization Act implemented in 1976 now allows sterilization as a form of birth control on request to any person 25 or older (and to those 18-24 years old with special permission). As a result, numbers of sterilizations jumped from the annual pre-1976 level of 1,000-1,900 to 5,200 in 1977 and 5,900 in 1978, when a third of them were obtained by men. Although still modest, these numbers are far from trivial. Sterilization should gain rapidly in the years ahead if its popularity in Sweden measures up to even half that in the U.S. where a national fertility survey revealed that already in 1976 sterilization was nearly up to pill use among all married couples with wives aged 15-44 (19 percent compared to 22 percent) and far more popular than the pill among couples with the wife aged 35-44 (29 percent versus 8 percent).[48]

The Swedish Institute: Photo by Bengt Malmqvist

Abortion

The increased use of effective modern contraceptive methods coincides with the sharp fall in Sweden's fertility since the mid-1960s. But increased abortion has probably also played a role.

Sweden's abortion law dates back to the 13th century. Abortion was regarded as enough of a public problem for severe penalties to be introduced in the 15th century and the death penalty in the 17th century. The death penalty was eliminated in 1864 and other penalties eased in 1890 and 1921. Although the 1921 law still prohibited induced abortion under any circumstances, genuine medical reasons had by then come to be accepted unofficially as sufficient justification.

Growing alarm over increasing illegal abortion led to a major investigation in the 1930s and in 1938 Sweden joined Iceland and Denmark as among the first countries in the world to permit abortion under limited conditions: medical (childbirth threatens the woman's life or health); humanitarian (rape or incest); or eugenic (danger of fetal abnormality). A 1946 amendment added sociomedical conditions (the woman's living situation could be taken into account) and another in 1963 accepted probable fetal injury as a sufficient reason. The next major step was the current law, implemented January 1, 1975. Among the world's most liberal, this law specifically recognizes a woman's right to alone decide on an abortion up to the 18th week of pregnancy.

Despite progressive liberalization, the law was interpreted with caution until the early 1960s. Administrative delays were frequent and the number of abortions consequently low: 6,300 at the peak in 1951 and 2,800 in 1960. Up to 1965, more than 85 percent of legal abortions required authorization by the National Board of Health in Stockholm and the remainder required certificates signed by two physicians. Under growing public pressure, practices were relaxed and by 1970 three out of five abortions were being granted by the less time-consuming two-physician procedure, applications increased, and numbers of abortions climbed steeply. By 1974, the year before restrictions were largely eliminated by law as well as in practice, 30,600 abortions were recorded—nearly ten times the 3,200 performed in 1962 (Table 8).

Table 8. Births and Legal Abortions: Sweden, 1962-1978

Year	Live births	Legal abortions	Abortions per 1,000 live births
1962	107,284	3,205	30
1963	112,791	3,528	31
1964	122,664	4,671	38
1965	122,806	6,209	51
1966	123,354	7,254	59
1967	121,360	9,703	80
1968	113,087	10,940	97
1969	107,622	13,735	128
1970	110,150	16,100	146
1971	114,484	19,250	168
1972	112,273	24,170	215
1973	109,663	25,990	237
1974	109,874	30,636	279
1975	103,632	32,526	314
1976	98,345	32,351	329
1977	96,057	31,462	328
1978	93,248	31,918	342

Sources: 1962-1975: Olav Meirik, Karl-Gösta Nygren, and Björn Smedby, "Birth Rate and Birth Control in Sweden 1962-1976," *Lakartigningen*, Vol. 75, No. 6 (1978) Figure 1, p. 426; 1976-1978 National Central Bureau of Statistics, *Population Changes 1978*, Part 3 (Stockholm: 1980) Tables 3.19 and 3.24.

Some observers feel that legal abortions have merely substituted for what would formerly have been illegal abortions in Sweden and consequently have had little net impact on the birth rate. Potts, Diggory and Peel, for example, point out that in the 1930s, before the first liberalization of the law in 1938, numbers of illegal abortions were estimated at 10,000 to 20,000 annually, or 100 to 200 induced abortions per 1,000 live births.[49] This is in the same range as the legal-abortion-to-live-birth ratios of 1968 to 1972 (see Table 8) when the crude birth rate was about 13-14—also virtually the same as in the 1930s. Several Swedish physicians, however, feel the rise in legal abortions reflects much more than just substitution for illegal abortion and thus must account at least in part for the fall in annual births and fertility rates from the mid-1960s to the mid-1970s, although improved contraception was probably equally important.[50]

In years to come, contraception is likely to displace abortion increasingly as the preferred approach of Swedish women determined not to go beyond their desired number of children, whatever that number may be. Annual numbers of abortions have leveled off since passage of the 1975 law, as also seen in Table 8. This could mean that another major objective of the law has begun to take effect. In addition to providing abortion on demand, the legislation sought to reduce the number of abortions by stressing contraception as the primary means of birth control, with abortion regarded as "an emergency measure." The new sterilization law was seen as part of this larger purpose. Efforts have also been stepped up to expand public contraceptive services by training 600 midwives to do gynecological examinations, insert IUDs, and provide pills, for example. There are now also 20 special family planning centers for young people. Family planning consultations, diaphragms, IUDs, and condoms are free at public health centers and pill costs are subsidized. And by 1977, some 5 million crowns ($1.2 million) had been allocated to increase family planning information, especially among youth and women's organizations.[51]

Mortality Trends

Unlike fertility patterns, recent Swedish trends in mortality have been mostly gradual and consistent and therefore require less attention.

From an average annual rate of 27 per 1,000 population in the second half of the 18th century, the crude death rate declined fairly steadily until it reached a low point of about 9.5 in the mid-1950s. Thereafter, it began to creep up and has been between 10.5 and 11.0 in recent years (Table 1, page 6).

The crude death rate is determined by death rates at each age and the age structure of the population. Age structure influences the crude death rate because death rates are much higher among the elderly than among younger persons. If the elderly portion of the population increases because of declining fertility and hence relatively fewer young people, the crude death rate is likely to rise. This is what has happened recently in Sweden. Until the mid-1950s, the continuing decline in age-specific death rates was great enough to more than offset the inflating effect of the population's aging on the crude death rate. After that, however, the aging of the population accelerated. In 1900, persons 65 and over made up 8.4 percent of Sweden's population. Half a century later in 1950, this portion had increased only 1.8 percentage points to 10.2 percent. But in the next quarter century, the figure grew by 5.3 percentage points to reach 15.5 percent in 1976. This sharp increase was mainly the result of the pronounced decline in the birth rate from the mid-1960s. (See "Changing Age Structure and the Elderly" following.)

The trend in age-specific death rates can be illustrated by life expectancy at birth (the average number of years a newborn could be expected to live if current mortality rates were to continue). This measure is constructed from age-specific death rates of a given year or period and thus conveniently summarizes their level at that time. As age-specific death rates fall, life expectancy rises. Table 9 (next page) indicates that Sweden's age-specific death rates have fallen steadily since the middle of the last century and life expectancy has risen accordingly, although the gain was appreciably slower after the 1950s. By 1978, life expectancy for Swedish women (78.6 years) was exceeded only by Iceland's (79.2 in 1975-76) and that of Swedish men (72.4) trailed only the figures in Iceland and Japan (73.0 and 72.5 respectively).

Interestingly, Swedish women had a 3.9-year edge over men in life expectancy already in the mid-19th century. The gap narrowed thereafter, but after World War II it widened rapidly, as in

Table 9. Swedish Life Expectancy at Birth 1851-1978 and International Comparisons

Year	Life expectancy at birth (years)		Sex differential
	Male	Female	(Female minus male)
	Sweden		
1851-60	40.5	44.4	3.9
1901-10	54.5	57.0	2.5
1941-50	68.1	70.7	2.6
1951-60	70.9	74.1	3.2
1961-70	71.7	76.1	4.4
1971-75	72.1	77.7	5.6
1976	72.1	77.9	5.8
1977	72.4	78.5	6.1
1978	72.4	78.6	6.2
	International Comparisons		
Iceland 1975-76	73.0	79.2	6.2
Japan 1976	72.5	77.4	4.9
Netherlands 1977	72.0	78.4	6.4
Norway 1976-77	72.1	78.4	6.3
United States 1977	69.3	77.1	7.8

Sources: Sweden: National Central Bureau of Statistics, *Population Changes 1978*, Part 3 (Stockholm: 1980) Table 4.17, p. 120; International: Population Division, United Nations, personal communication, May 1980; United States: National Center for Health Statistics, *Vital Statistics of the United States*, Vol. II, Section 5, *Life Tables* (Hyattsville, Md.: 1980).

most other industrialized countries, and was over six years by 1978. This is further illustrated in Figure 6. Since the late 1940s, the decline in age-specific death rates has been much greater for females than for males, except among infants and children under 15. The figure also reveals that mortality declines in this period, as in the past, have been much greater for infants and children than for older persons. The decline was least among the elderly aged 65 and over.

Much of the steady gain in life expectancy is due to the historical fall in the infant mortality rate (deaths under one year of age per 1,000 live births). Sweden has the world's longest series of infant mortality data, dating back to the early 18th century. At the end of that century, infant deaths stood at about 200 per 1,000 live births. The rate dropped 100 points in the next 100 years and another some 75 points, to 24, by the late 1940s. The pace of the decline slowed slightly after that but in 1966-70, the rate was down to 12. Contrary to expectations, it has continued to fall rapidly. By 1978, Sweden's infant mortality rate was 7.8 (6.7 for girls and 8.9 for boys)—the lowest rate in the world, as it has been for many years. Next lowest in the world in 1978 was Japan at 8.4; the U.S. infant mortality rate in 1978 was 13.6.[52]

Sweden's ability to keep infant—and all—death rates low is not a recent development. With Norway, Sweden had the lowest infant and child death rates in Europe more than a century ago. A U.S. observer notes:

> "Medical care, like education, has been regarded as both a communal responsibility and an individual right in Sweden long before the advent of the modern welfare state. . . . Prenatal care, delivery, and postnatal care

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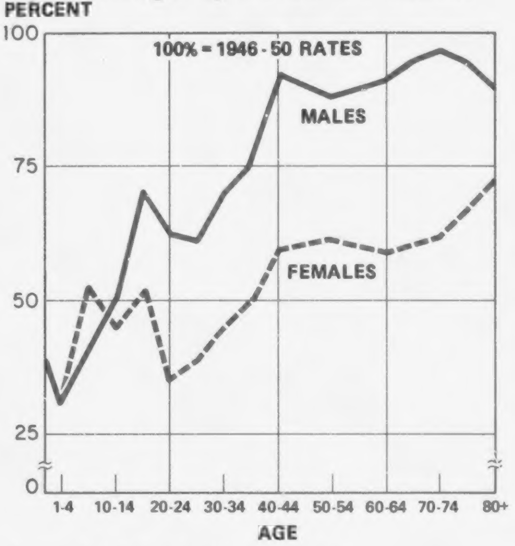
Figure 6. Swedish Age-Specific Death Rates 1972-76 as Percentage of 1946-50 Rates



Source: See Figure 2, Diagram 3.2, p. 21.

have been free and readily available throughout Sweden for many decades. Sustained professional care of pregnant women and later of their babies is universal. Such established and routinized care has not come this far in the U.S., and it is free only for the indigent."[53]

The unexpectedly rapid infant death rate decline of recent years is credited to continued improvements in medical diagnosis and prenatal care. Also important, as noted, is that two-thirds of all births now occur to women in their twenties—ages when the risk of delivery complications are least.

Changing Age Structure and the Elderly

A population's age structure (the relative number of people in different age groups) is shaped by trends in fertility, mortality, and migration. Normally, fertility is the major influence. A sustained high level of fertility produces a youthful population with a large proportion of children and youth. As fertility falls, the population "ages" with a decline in the proportion of young people and a relative increase of persons in the older ages. For Sweden, the series of population pyramids in Figure 7 displays this aging process graphically (next page).

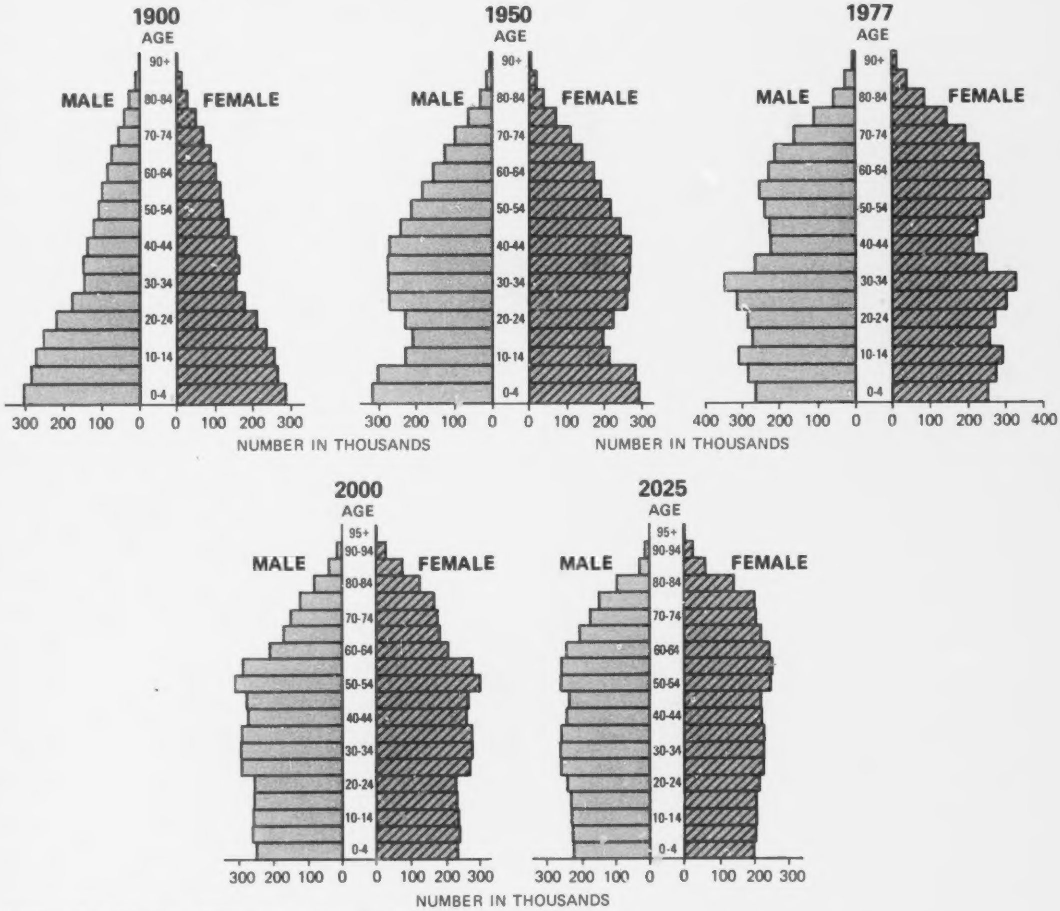
The pyramid for 1900 has the triangular shape characteristic of a youthful population, reflecting the moderately high birth rates (around 30 per 1,000 population) of the second half of the 19th century. The slight break in the pyramid at ages 30-40 is explained by the heavy emigration of young men in particular during the 1880s and 1890s. In the 1950 pyramid, the indentation at ages 10 to 24 reflects the birth rate drop between 1925 and 1940 and the broader base (children under 10) reflects the rising birth rates of the 1940s.

With the lengthening period of low fertility, Sweden's population pyramid was beginning to assume the rectangular shape of a "stationary" population by 1977. The numbers of people in the younger ages were more nearly equal to those in the older age ranges. The pyramids for 2000 and 2025 are based on the main population projection described earlier which assumes a total fertility rate rising to 1.8 in 1985 and constant thereafter and no net immigration after 1985. Sweden's actual population age structure in 2000 and 2025 will probably turn out to be more irregular than depicted here because fertility will undoubtedly not remain unchanged. However, the fluctuations should be more modest than previously and the level of fertility could very well remain low. This would result in a continued equalization of age cohorts and an increased aging of the population.

Average population age and proportion of elderly

In 1900 already, 30 was the average (mean) age for both men and women. By 1950, the average was up to about

Figure 7. Sweden's Population Age Structure 1900, 1950, 1977, and as Projected for 2000 and 2025



Source: See Figure 2, Diagrams 1.1, p. 8, and 5.3, p. 35.

35 years. In 1977, it stood at 37.0 for men and 39.2 for women. (The *median* age of Swedish men and women in 1977 was about 35, compared to a median of 29.4 years for the U.S. population in 1977.) If the current medium population projection holds (a constant TFR of 1.8 and no net immigration after 1985), the figures for 2025 will be 40.4 for men and 43.4 for women.[54] The higher population projection, which assumes a constant TFR of 2.1 after 1985, would reduce the 2025 figures by about three years and the lower projection of a constant TFR of 1.5 would add about three years. The population's average age would also be lower in 2025 if Sweden continues to have some net immigration. Net immigration has a significant rejuvenating effect on a population because immigrants tend to be mostly young adults and children. Also the fertility of recent immigrants to Sweden has been higher than that of native Swedes, as noted in the next section.

Sweden's rising average population age of course reflects increasing proportions of the elderly. As noted, the proportion of persons of retirement age, 65 and over, nearly doubled from 8.4 percent to 15.7 percent between 1900 and 1977. (In the U.S., the proportion of the population in this age range is currently about 11 percent.) At the same time, however, the proportion of youngsters under age 15 declined by a greater amount—from 32.4 percent to 20.4 percent, or 12 percentage points. As a result, the ratio of people in the "economically productive" ages (15-64) to those in the "dependent" ages (under 15 and over 64) became increasingly favorable during the first three-quarters of this century. However, the easing of the dependency load that might have resulted from these shifts in age structure was offset by the extension of education—especially higher education—and the development of a national pension system. Young people began to stay in school longer and older people retired earlier.

If the main population projections materialize, the proportion of persons aged 65 and older will rise slightly to 16.4 percent in 2000 and then jump to 20.0 percent in 2025. The proportion of children under age 15 will decline continuously while the percentage of working-age adults would first rise a bit and then decline.

Within the working-age proportion of the population and among the elderly group there have been and are projected to be important variations. The working-age population itself has aged and will continue to do so over the 1977-2025 period, with a decline in the proportion aged 15 to 39 and increases in the relative numbers of people 40-64 years old. Similarly, the group of 65-and-overs will grow older. The total number of persons in the retirement ages, 65 and over, will increase by 260,000 from 1.30 million to 1.56 million between 1977 and 2025. But some 235,000 of that increase will come among the elderly who require the most costly services, those aged 75 and over. Further, most of this increase will occur during the decade before 1990. More troublesome still is the foreseeable increase of the very old, aged 85 and over, from 90,000 in 1977 to 160,000 in 2000, a growth of almost 80 percent.[55]

Cost of elderly support

Regarding his country's demographic outlook, Swedish demographer Ingvar Holmberg comments:

> "Despite the somewhat gloomy picture sometimes painted, there is probably no one who really believes in a picture of Sweden as a country with an increasingly declining population, populated mainly by old people and only a small number of children: a country where the former day nurseries are used as pensioners' dwellings and where industry is kept going by an increasingly aging workforce."[56]

The figures on the elderly cited above, however, are numbers, not percentages. Thus even in the unlikely event of a sudden rise in the birth rate, there is no escaping the added burdens of care and cost that will come with the rapid increase in absolute numbers of the aged whatever may happen to their *relative* numbers. That the increases will be particularly rapid during the 1980s is unfortunate, given the difficulty Sweden, along with the other Scandinavian welfare states, is currently experiencing in meeting the mounting costs of inflation-bloated social benefits. From this perspective, Sweden would be better off with no immediate reversal in its declining birth rate for that would increase the absolute and relative number of youthful dependents without diminishing the absolute number of aged dependents. Between 1990 and 2005, the number of elderly will decline somewhat with the entry into retirement age of the smaller birth cohorts of the 1930s. At that time, other things being equal, an increase in the birth rate would be more affordable.

Sweden is already experiencing what Holmberg terms a "crisis" in finding

The cost of supporting the elderly is escalating in Sweden and is destined to rise still higher with the projected increase in the number and proportion of elderly persons.

enough staff to provide the medical and long-term care needed by the very old. But overwhelming this is the escalating financial cost of supporting retired persons. The official age for retirement was lowered to 65 in 1976, confirming what had actually been long-standing practice for most workers. All retired persons 65 and over receive a basic pension and, if they have worked, a supplementary pension. The two pensions together add up to two-thirds of the average income received during a person's 15 best-paid working years. Since 1976, employed persons aged 60-65 have also been permitted to cut down on working hours, receiving a partial pension in return. In early 1978, there were about 1.6 million full or partial pensioners compared to just over 4 million employed persons. All three pensions are adjusted upward monthly to keep up with inflation.

Sweden's bill for all social welfare costs in 1975 totaled 71.2 billion crowns ($17.1 billion at the current exchange rate of 24¢ per crown), representing an outlay of 8,680 crowns or $2,080 per capita and one-fourth of the country's gross domestic product. Of this, some 21 billion crowns went for pensions. Another 3 billion was spent for homes and other special assistance for the aged, and "sickness" benefits for persons 65 and older are estimated at an additional 10 billion crowns. Thus, some 48 percent of Sweden's total social welfare budget of 71 billion crowns in 1975 went for support of the elderly.[57]

Both the share of the budget and amounts spent on the elderly have escalated since then. In just the three years between 1975 and 1978, total social welfare expenditures increased by a fifth (71.2 to 87.0 billion crowns) but the cost of basic pensions climbed by half (15.8 to 23.5 billion) and the outlay for supplementary pensions went up nearly 150 percent (5.0 to 12.3 billion crowns).[58] Obviously the needs of its growing elderly population have much to do with Sweden's budget deficit which in 1980 amounts to 10 percent of the country's gross national product (compared to a budget deficit of less than 2 percent of GNP in the U.S.).[59] And that elderly population is destined to grow relentlessly over the coming decade.

International Migration

As we have seen, immigration and emigration have played important roles in Sweden's population growth. Emigration predominated until 1930, helping to relieve the pressure of the growing population on the meager resources of the poor agrarian society of the 19th and early 20th centuries. But in the past 50 years, mainly because of the rise in levels of living that accompanied social and economic development, Sweden has become an immigrant rather than an emigrant society. Coming at a time when its natural increase has reached low levels, net immigration has thus been increasingly responsible for continued Swedish population growth. It has also begun to reduce the high degree of ethnic, linguistic and cultural homogeneity that has prevailed for centuries in Sweden, prompting a growing concern about the future character of the society.

In the poor agrarian society of the mid-19th century, there were many who were attracted to the opportunity to better themselves in the U.S. The trickle overseas began in the 1840s and grew modestly until a famine in Sweden caused an explosion of emigration in the late 1860s. After a brief slowdown, "America fever" reached its heights for about 15 years, beginning in the late 1870s. The volume of emigration was much lower thereafter, except during the first decade of the 20th century and briefly in the early 1920s following World War I.

All told, from 1865 to 1930, nearly 1.4 million Swedes left their country. Close to 400,000 later returned. Since Sweden's population averaged about five million during this period, the one million net emigrants were obviously a considerable loss, particularly since most were young adults. There was not only the direct loss of the emigrants themselves but also the indirect loss of their descendants. It has been estimated that:

> "If an attempt had been made in 1850 to make a projection of the trend of population in Sweden up to the beginning of the 20th century, the following figures would have been produced:
>
> 1900 6.5 million
> 1910 7.4 million.
>
> In these years, the actual population counts were:
>
> 1900 5.1 million
> 1910 5.5 million.
>
> . . . The 'loss' of nearly two million [as of 1910] was attributable to rather more than a million emigrants and their decendants."[60]

From emigration to immigration

Emigration slowed in the late 1920s after passage of restrictive immigration legislation in the U.S. in 1923 which reduced the opportunity for Swedes to leave for what had long been their favorite destination. (Previously over 80 percent of Swedish emigrants had gone to the U.S.) High unemployment in the U.S. during the Depression of the 1930s further reduced that country's attraction for Swedish emigrants. (Indeed, many Swedes left the U.S. for Sweden during this time.) Nor were other countries attractive sites for relocation during the 1930s. Finally, emigration was virtually extinguished during the World War II years of 1939 to 1945. (However, many refugees came to Sweden during those years.) After the war, the Swedish economy expanded rapidly, and the demand for labor outstripped the supply. There were jobs for everyone—indeed, a substantial need for foreign labor—at increasing levels of pay. Sweden became a country to go to, not one to leave.

Refugees were the main type of immigrants in the 1940s, but foreign workers predominated during the next two decades. Total net immigration for these decades was:

1940s	134,000
1950s	106,000
1960s	235,000

During the 1950s, the foreign workers came primarily from West Germany and the other Nordic countries (Finland, Norway, Denmark, and Iceland), especially after 1954 when an inter-Nordic free labor market was established.

Two major waves of immigration highlighted the 1960s. The middle of the decade saw a sharp influx of workers from Southern Europe, especially Yugoslavia, Greece, Italy, and Turkey. Immigrants from these four countries went from less than 3,500 in 1964 to 9,000 in 1965 and over 12,000 in 1966. An economic boom in the late 1960s attracted a second, considerably larger wave. For 1968-1970, the annual average totaled close to 70,000, up from some 42,000 during the preceding three years. Finns, who had been the largest group of immigrants for some time, comprised over half the total in this wave.

With the fading of the boom, immigration subsided to nearly 30,000 in 1972 and 1973. Although it went up again to about 45,000 per year in 1975-77, the peak was substantially less than that of the late 1960s. This reflected stricter application of restrictive regulations adopted in 1967 as the business cycle headed down again during the early 1970s. Prompted by concern over the impact of growing immigration on social welfare, housing, and employment opportunities for "marginal" Swedish workers, i.e., women, the elderly, and the handicapped, these regulations required non-Nordic citizens to have jobs, labor permits, and housing all arranged before entering Sweden.

These became increasingly difficult to get during the 1970s. As a result, the number of immigrant workers entering Sweden from non-Nordic countries dwindled to almost nothing. However, there was a considerable increase in refugees. Between 1974 and 1978, Sweden took in almost 12,500 Latin Americans, for example, most of them refugees fleeing government upheavals, particularly the ousting of Chile's President Allende in 1973.[61] Relatives of immigrants already in the country have comprised another substantial category of recent immigrants. With these two categories now making up larger fractions of total immigrants, the relationship between the business cycle and immigration has weakened. Finns remain the largest single national group of immigrants, comprising at least a quarter of the total each year. Citizens of other Nordic countries, while also continuing to enjoy the freedom of movement of the Nordic common labor market agreement, have come in more modest numbers (except for the 17,000 Danes who found economic conditions at home too depressing in 1974 and 1975).

Emigration has generally amounted to less than half the volume of immigration in the post-World War II period except for 1971 when immigration exceeded emigration by only a few thousand, and in 1972 and 1973 when the outflow exceeded the inflow by about 11,000 each year, the only two years of migration loss since 1929.

The figures on emigration largely reflect return migration. Almost half of postwar immigrants have emigrated after a short time in Sweden, most often in the year following the one in which they came. Immigrants from Northern Europe have been much more likely than those from Southern Europe to return home. With return migration accounting for so much of emigration, the size of each year's outflow has been closely related to the size of the inflow in the immediately preceding years. Thus the large increase in emigration in 1971-73 is partly explained by the large increase in immigration in 1968-1970. And as immigration fell subsequently, so did emigration.

Demographic impact of immigration

Table 10 lists the numbers of foreigners in Sweden at the end of 1977 by country of origin. As might be expected, Finns comprised by far the largest proportion: 45 percent of the total of 424,400. Yugoslavians, the next largest group, made up just under 10 percent. In 1977 there were also an additional 300,000 immigrants who had become naturalized Swedish citizens and another some 300,000 persons who were born as Swedish citizens but who had a mother or father who was not a citizen. Currently, it is estimated that over a million of the 8.3 million people in Sweden—or as many as one in every eight persons—are either immigrants themselves or children of postwar immigrants.[62] Al-

Table 10. Foreign Citizens in Sweden by Country of Origin: December 31, 1977

Country of origin	Number	Percent
Finland	188,972	44.5
Yugloslavia	40,796	9.6
Denmark	34,268	8.1
Norway	27,356	6.4
Greece	18,361	4.3
West Germany	16,147	3.8
Turkey	13,372	3.2
Poland	8,609	2.0
Great Britain	8,347	2.0
United States	6,102	1.4
Italy	5,749	1.4
Austria	3,790	0.9
Hungary	3,102	0.7
Other	49,989	11.7
Total	424,445	100.0

Source: National Central Bureau of Statistics, *Population Projection for Sweden 1978-2025 (Information i prognosfrågor* 1978:5) (Stockholm: 1978) Table 4.2, p. 29.

though the population is still highly homogeneous, this is a big change from the 1930s when the shift from emigration to immigration began. At that time, less than 0.3 percent of the population held foreign citizenship (compared to 5.1 percent in 1977) and the numbers of naturalized citizens and immigrant children were probably equally negligible.[63]

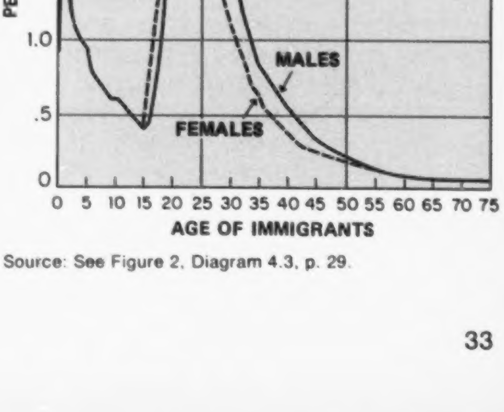
The demographic impact of the large postwar immigration has obviously been substantial, via natural increase as well as the direct gain from the excess of immigrants over emigrants. From the beginning of 1944 to the end of 1977, the excess of immigrants over emigrants amounted to half a million (the difference between some 1.1 million in and 0.6 million out) or about 29 percent of the 1.74 million added to the Swedish population in those 34 years. If one also takes into account the natural increase (excess of births over deaths) of immigrants, the contribution of immigration to the growth of 1.74 million in this period was fully 800,000, or almost 46 percent, with natural increase making up about 17 percent of the gain.

As is often the case, a large proportion of the migrants have been young adults (Figure 8). This younger average age of the aliens means that their crude death rate is considerably lower than the rest of the Swedish population (even though their age-specific death rates are a little higher than those of Swedish citizens). At the same time, the fertility of foreign women in Sweden is greater than that of Swedish women. In 1978, for example, total fertility rates per woman by country of citizenship were:[64]

Sweden	1.56
All other	2.12
including:	
Denmark	2.00
Finland	1.79
Norway	1.87
West Germany	1.93
Greece	2.72
Yugoslavia	2.10
Turkey	5.23

It follows that the rate of natural increase is much lower for Swedish citizens than for aliens residing in Sweden.

Figure 8. Age Distribution of Immigrants to Sweden: 1973-1977



Source: See Figure 2, Diagram 4.3, p. 29.

Table 11. Natural Increase Among Swedish Citizens and Aliens in Sweden: 1971-1978

Year	Excess of births[a] over deaths		
	Swedish citizens	Aliens	Total
1971	22,116	9,651	31,767
1972	19,194	9,023	28,217
1973	15,779	8,244	24,023
1974	15,365	8,193	23,558
1975	7,266	8,158	15,424
1976	- 600	8,268	7,668
1977	- 232	8,087	7,855
1978	- 4,602	8,169	3,567

Sources: National Bureau of Statistics, *Population Changes*, Part 3, for each of the years listed above.

[a] Births according to citizenship of the mother.

In 1972, natural increase was 3.1 per 1,000 for Swedish citizens and 23.3 per 1,000 for aliens.[65] As we have seen, Sweden's total rate of natural increase declined steadily throughout the 1970s and has been below one per 1,000 population since 1976 (see Table 1, page 6). The more detailed data shown in Table 11 reveal that the decline was caused by a steady fall in the natural increase only of Swedish citizens. Every year from 1976 to 1978, at least, there were fewer births than deaths among the Swedish majority of the country's population, especially in 1978. The fact that overall natural increase has not yet turned negative is thus entirely due to continued natural increase among the small alien minority.

Currently, then, all of Sweden's low population growth is dependent on immigration. Of the 2.29 per 1,000 total population gain in 1979, a quarter (0.59 per 1,000) was due to natural increase (among aliens only) and the other three-quarters (1.69 per 1,000) was due to net immigration (Table 1). Consequently, unless the fertility of Swedish citizens increases considerably, Sweden is faced with a dilemma. On the one hand, if it substantially reduces the volume of net immigration, its population may well decline. On the other hand, if it continues to accept the volume of net immigration that has prevailed during the 1970s, let alone during the whole postwar period, and if current trends in natural increase persist, it is faced with a challenge for which its history has not prepared it: how to go about incorporating foreigners into Swedish society. Indeed, even if there were no net immigration, the Swedish population would continue to become more heterogeneous if natural increase continues to be negative for Swedish citizens, the vast majority of whom have been born in Sweden to Swedish parents.

Immigration Policy

Sweden's shift from an emigration to an immigration country was not the result of conscious policy. Rather, an immigration policy has evolved after the event and can be traced through three periods: 1944 to 1963, 1964 to 1973, and 1974 to the present.

Immigration during the first 20 years was largely in response to Sweden's feeling of a moral obligation, as a neutral nation spared the ravages of World War

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II, to accept displaced persons and refugees and its great postwar need for labor to maintain the rapid pace of economic expansion. No one at the time recognized what is now seen as the beginning of a persistent process with profound implications for Swedish society. International migration was not even taken into account in population projections until the 1960s.

The unexpected sharp increase in net immigration from 106,000 in the 1950s to 235,000 in the 1960s led to the concern over the threat which immigration posed for Sweden's well-established welfare state that characterized the second period (1964-73). Efforts were begun to provide foreigners with the same benefits and protections enjoyed by Swedish citizens lest they become an exploited, problem-ridden underclass. In the late 1960s, however, the main preoccupation was how to facilitate immigrants' "social" adjustment. Should they be "assimilated" (i.e., become Swedish in every respect, giving up the language and culture of their home countries) or "integrated" (allowed to maintain their distinctive group ethnic identities)? As a result of this "melting-pot" debate, a Commission on Immigration was established in 1968 to investigate what public measures should be taken on behalf of immigrants and ethnic minorities.

The commission's final report, issued in 1974, gave the preference to integration. Widely accepted by the public and government, this led to passage in 1975 of a bill which defined Swedish immigration and minority policy for the first time: *equality* between immigrants and Swedes, cultural *freedom of choice* for immigrants, and *cooperation and solidarity* between the native Swedish majority and various ethnic minorities. Thus "it was finally officially stated that immigration was beneficial to Sweden" for its cultural as well as economic contribution.

To implement this policy emphasis on ethnicity and pluralism, all Swedish municipalities have been required since 1977 to provide immigrant schoolchildren with several hours per week of instruction in their native languages.[66] In 1977, 30,000 students received instruction in over 50 languages. On the other hand, programs have been established to help immigrant adults learn Swedish and a 1973 law requires employers to give immigrant employees 240 hours paid leave of absence to attend free lessons in basic Swedish.

State grants are also provided to immigrant and ethnic minority organizations, which have a combined membership of 80,000. State support also goes to the ethnic press and theatrical activities, publication of literature in minority languages, and to public libraries to buy foreign literature.

An important goal of the 1975 policy was to increase immigrants' opportunities to participate in political decision-making. The right to vote and run for local or regional office was granted to all aliens who have lived in the country for at least three years, a step which the Swedes claim to be the first to have taken. In the 1976 election when the law went into effect, 60 percent of 220,000 eligible aliens voted and some 400 immigrants were elected to public office.

Although it is too soon to make a final judgement, there are indications that a substantial gap still exists between the policy goal of integration with equality, cooperation, and immigrant freedom of choice and its realization. A Swedish reporter observes, for example, that the law entitling foreign workers to 240 hours of Swedish language instruction during paid working hours has "turned into a fiasco" because "companies try to get round the law . . . by not hiring people who have not already received this instruction."[67] David Schwarz, publisher of the *Scandinavian Migration and Ethnic Minority Review* [Invandrare och minoriteter] and himself an immigrant, went much further in 1979, claiming that:

> "Now, three years after the formulation of the lofty goals for immigration . . . everything has continued more or less as it was before. In practice, the school still works towards making immigrant children Swedish and the authorities still continue with their old policy of trying to 'solve' the problems of the immigrants without inviting the participation of the immigrants themselves."

Of the one billion crowns per year currently spent on measures relating to immigration, he asserted:

> "Most goes . . . to solving the immediate problems that arise in connection with the move to a new country (instruction in Swedish, information about Swedish society, work, housing, etc.) at the expense of the long-term aspects of the situation such as cultural and educational problems, equality, and relations with the majority of the population. As a result, the feeling of 'foreignness' is central to the way immigrants perceive themselves as well as to how they are regarded by Swedes."

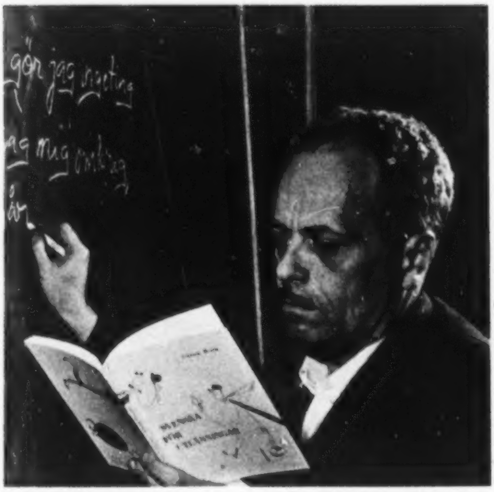
He continued:

> "The situation has already gone so far that there is a great risk of its developing into a very explosive and intractable social problem. From there, it is not such a long step to the policy of throwing out immigrants when they are no longer needed in Sweden, as is done in many other countries."

The de facto practice of assimilation "must be abandoned," he asserted:

> "and immigrants must be allowed to become an integrated part of Swedish society on the same conditions as the Swedes themselves. Unfortunately both the political will and the public support for pursuing such a course are still lacking."[68]

Five Members of Parliament interviewed during the campaign preceding the September 1979 parliamentary elections confirmed the lack of political, if not public, concern for the "unsatisfactory lives and circumstances of immigrants."[69] Former Social Democratic Deputy Minister of Immigrant Affairs Anna-Greta Leijon noted: "As a politician you don't become popular on immigrant issues . . . But a lot of people admit that they're important, and there's a lot of discussion about them." Another MP observed that immigrants "aren't exactly vote-catching" perhaps in part because 400,000 of the then 700,000 adult immigrants still had no right to vote in parliamentary (i.e., national) elections. (In 1979, only the Communist Party favored granting such a right.) The then Deputy Minister of Immigrant Affairs, Eva Winther, felt that political disinterest in immigrant matters merely reflected "the distance that exists between Swedes and immigrants." All five MPs agreed that relations between Swedes and immigrants needed to be improved, that immigrant issues were important despite their lack of political salience, and that the consequences of not solving them would be serious.



Swedish Information Service

Integrating immigrants into Swedish society has caused problems, despite conscientious policy efforts. But without immigration Sweden's population could decline sooner and faster than projected.

Although immigration issues are not yet as political in Sweden as in the U.S., they are equally vexing and visible. In both countries, they have profound and pervasive implications for the nation, provinces (states in the U.S.), and the local community and require a coordinated strategy between the three levels of political action to tackle successfully. Immigration concerns also influence and are affected by important international relations, a fact which constrains what unilateral action these two "receiving" nations might take. In sum, immigration problems in both countries are likely to get worse before they get better. And it probably will require major changes in the perception and evaluation of immigrants, much hard work, and the expenditure of a lot of money before the situation improves.

Recent Population Debate

Immigration issues

As the preceding section suggests, much of recent public discussion of population issues in Sweden has focused on immigration. With the labor needs of the 1950s and 1960s replaced by the growing economic difficulties of the 1970s, free labor immigration from non-Nordic countries has been eliminated. However, the humanitarian willingness of Swedes to accept refugees has compensated considerably for the decline in non-Nordic immigrant workers as has their willingness to admit relatives of immigrants. (An "educated guess" puts the proportion accounted for by these two categories at almost 60 percent of the 39,000 immigrants in 1977.[70])

Although legislation has been enacted to cope with the threat to Sweden's social welfare standards which would be posed by large-scale immigration if immigrants were exploited and to enunciate and implement a policy of integration stressing ethnicity and pluralism, a "lively debate . . . on the lives and circumstances of immigrants" is still being conducted.

"Swedish newspapers often write about individual deportation cases and occasionally about the lives and circumstances of immigrants generally. Among ordinary people and among politicians, immigrants are a topic of heated, passionate and frequent discussion.

What do people discuss? The native languages of immigrants. How far should we pursue the demand that immigrant children be entitled to learn their home language? Should they attend their own day-care center groups and school classes, where their home language is spoken?

Why do immigrants have such a hard time with the Swedish language, and why has the law entitling them to 240 hours of Swedish language instruction during paid working hours turned into a fiasco?

Should immigrants have the right to vote in Parliamentary elections?

Is there widespread racism in Sweden? If so, why, and what can be done to end it?"[71]

Facing zero population growth

Although the heavy net immigration of the 1960s had a considerable impact on population growth, immigration issues were not then discussed in relation to population growth. Population growth became an issue only in the mid-1970s, stimulated by publicity surrounding the World Population Year and the United Nations World Population Conference of 1974 and the steady decline in the birth rate from 1971 on.

Two main lines of argument have characterized the ensuing discussion. One contends that measures are needed to prevent population decline because the decline itself and associated aging of the population would lead to economic stagnation and increasing inequities in income distribution. The other line sees fertility decline as an indication of a social problem which could be solved by improving the social and economic situation of families with children and by making society a friendlier place for children. (Sweden has now gone much further than most nations in making society at least less inimical to children. Since 1973 there has been an "ombudsman" for children, and a governmental Commission on Children's Rights pushed through a "no-spanking law" in

1979 and currently proposes legislation to permit children to divorce their parents.)

Much of the lively debate has been carried on in the press, with particular attention focused on possible reasons for the fall in fertility. A major reason given is the economic disadvantages of having children under existing conditions, even with generous child-related government support. Maintaining Sweden's welfare state costs workers over half their total earnings in national and local taxes, with many above-average wage earners paying much more than that. And with inflation and a standard sales tax of 20 percent, prices are high for many staples: new automobiles, for instance, cost from $10,000 to two or three times that much, gasoline has been at least $2 a gallon for many years, and steak costs about $8 a pound. Other reasons conjectured for falling fertility include the problems of juggling home duties with a job for the rapidly increasing proportion of Swedish women entering the labor force, the much greater availability since the 1960s of effective contraception and legal abortion (facilitating the achievement of desired family size), the shift in the source of care and support of the elderly from one's children to society, and even a possible women's protest against a male-dominated society. On the last point, a woman's journal editor argues:

> "Women are tired of bringing children into a society where they are not welcome. They want to give their children a complete life. If they cannot get men to share the housework and child care, if there are insufficient good day nurseries, if both parents are not given time to be with their children (because they both have to work), then women will refrain from having children, however much they want them."[72]

Regarding the consequences of the decline in the birth rate, Ingvar Holmberg sees "two almost diametrically opposite views," one held by the older generation and the other by younger adults.[73] The former foresee long-run difficulties because of the adverse effects of age structure changes on the supply of labor and society's ability to care for the sick, the elderly, and children. The latter counter that Sweden already has major shortcomings in the care sector which have nothing to do with fertility decline. The chronic shortage of staff must be solved by organizational changes, they say. As for labor supply, these younger adults contend that a proposed shortening of the work week to 30 hours would affect the volume of available labor much more than a continued fall in fertility. On the other hand, "a sharp increase in the birth rate would lead to difficulties for the educational system and for new entries to the labor market when the large number of children born grow up."[74]

Not surprisingly, defenders of these two positions also disagree on the desirability and feasibility of influencing the current population trend. Those concerned about declining fertility favor measures to improve the economic situation of families with children by granting parents extra credit toward the national supplementary pension and providing them with more favorable tax regulations and larger child subsidies. It has also been suggested that child-bearing and rearing should be made more compatible with parents' labor force participation by shortening the work day, providing sufficient day-care service, and making it easier to get help or time off when children are sick. On the other hand, those who do not believe the birth rate decline is having or will have seriously adverse consequences see no good reason to try to reverse the trend. The adverse effects of low fertility, in their view, can be handled by planning. And it is easier to do this than to cope with the consequences of fertility fluctuations.

Finally, there has been disagreement as to the desirability and feasibility of relying on immigration to solve the problems of population decline and labor supply. Those who favor this solution note the economic advantage to Sweden of gaining adult workers for whom the childrearing and education costs have been borne by other countries. This view is countered by the observation that the sending countries are becoming increasingly aware of the loss which they suffer because they bear such costs and because their emigrants are often skilled workers whom they need. In addition to the growing demand for compensation from sending countries, there is the danger of becoming too dependent on the labor of foreign citizens whose continued services cannot be assured. And there is concern about the impact of increasing heterogeneity resulting from continued immigration, in particular the difficulties of learning to accept and live with people whose physical appearance, language, and culture are different.

Conclusion

Historically low fertility and unprecedentedly high net immigration have clearly posed serious problems for Sweden in recent years. Swedes may disagree on the nature of the problems, how serious they are, and what action should be taken. Still, they have recognized the importance of the issues and have taken action on immigrant problems, admitting the probable need for more action there. Nothing has yet been done about fertility, but Parliament and the public have been paying increasing attention to the birth rate decline and its implications. Several bills concerning fertility have been introduced in Parliament and, if natural increase turns negative, new legislation seems likely.

One reason for their difficulties in deciding what to do about fertility is that Swedes know little about it because they have neglected to study it. (Indeed, with some notable exceptions such as the historians of Uppsala University who have been studying emigration to the Americas for many years, demography has been neglected generally. This is surprising in view of Sweden's long record of reliable demographic data and outstanding analysis of them done in the past.) The oversight has now been recognized by Parliament and the government, however, and efforts begun to rectify it. Under way is a National Central Bureau of Statistics study of the causes of fertility decline. This has three stages. Already completed and reported is the first stage which called for a review of Swedish and international trends in fertility and of the literature on the dynamics of fertility in order to construct a theoretical framework and hypotheses for further research and testing on the determinants of fertility decline. The second and third stages comprise an analysis of the demographic and socioeconomic aspects of fertility changes based on existing data from recent censuses, which Sweden now conducts every five years, and other files, and a survey to gather data directly from individuals and households.

With immigration, in contrast to fertility, the central problem is not theoretical understanding of its causes but rather how to deal with the practical consequences. It took two decades for Swedes to recognize the pervasive and enduring implications of their fundamental shift from an emigrant to an immigrant society. Was this also due to the neglect of demography? Or does it reflect social scientific neglect of ethnic differentiation, which would not be surprising in an extremely homogeneous society? In any case, Sweden has now begun to make up for lost time in the realm of immigration with the development of a systematic policy and programs to implement it.

The legislated objectives—equality, freedom of choice, and cooperation—are admirable. So far these appear to be more promise than fulfillment, but more than a good beginning might hardly be expected in such a historically short time as 15 years. For a citizen of the United States there is much to admire in the Swedish record. Despite a far longer history of immigration and heterogeneity, this country has made much slower progress toward a set of policies designed to ease immigrants' social adjustment, let alone one so attractive as Sweden's.

Another lesson that might be drawn from the Swedish record is the part international immigration could play in staving off actual zero population growth in countries now experiencing very low fertility and the profound effect immigrants might have on the nature of a ZPG society once reached. The subject tends to be neglected in the literature on the ZPG society, at least by demographers who either omit international migration altogether in their theoretical models or make conveniently simplified assumptions about it.

Another implication of the Swedish case for characterizations of the ZPG society is that the aging of the population will be greater than has been contended, at least by Lincoln Day in his 1978 *Population Bulletin,* "What Will a ZPG Society Be Like?" In his "hypothetical stationary population," Day calculated the proportion of the population aged 65 and over as 15.2 percent, pointing out that this was little more than the 14.8 percent of the population in this age range in Sweden in 1974. Only three years later, in 1977, this percentage was already up to 15.7 percent in Sweden and although it is expected to rise to only a little over 16 percent by 2000, the projection for 2025 is 20 percent.

For whatever reasons, this is much larger than the 15.2 percent of elderly persons in Day's hypothetical ZPG population. If the age structures of ZPG populations turn out to be more like that projected for Sweden in 2025 than that of Day's model, the impact of an aging population is likely to be much more pronounced than Day has conjectured. As a test case, Sweden bears watching. □

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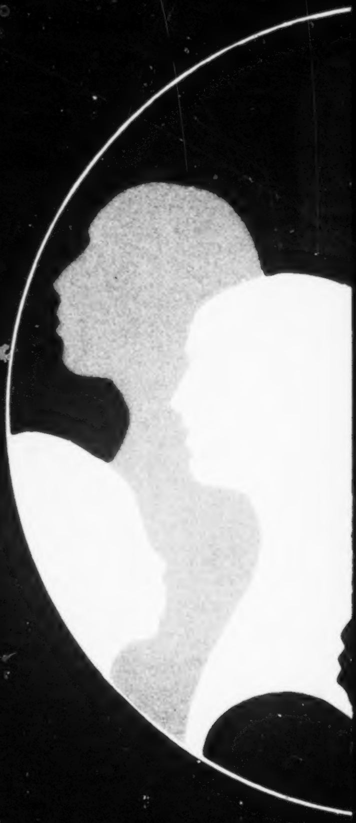

ERRATA

CORRECTION ON PAGE 4, LEFTHAND COLUMN, BOTTOM PARAGRAPH

Note line missing from the first sentence inside parentheses:

> (Twenty-four countries containing 16.3 percent of the world's population currently have a replacement-level total fertility rate of 2.1 births per woman or lower.*